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PHYSICS ABSTRACTS

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Physics Abstracts

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PHYSICS ABSTRACTS

Vol 60 APRIL 1957 Number 712

MATHEMATICS 51

512.94

2907. QUATERNIONS AS 4-VECTORS. M.J.Walker.
Amer. J. Phys., Vol. 24, No. 7, 515-22 (Oct., 1956).

The development of the algebra of quaternions is reviewed and discussed from a modern viewpoint stressing their aspect as 4-vectors and their educational value to the student of physics. Their relationship to 3-vectors, tensors, and complex matrices is noted. Geometrical visualization of their properties is developed. Their application to problems of polarized radiation and special relativity is described. A.

517.512.2

2908. SIX TYPES OF FOURIER SERIES REPRESENTATIONS. E.Ikenberry.
Amer. J. Phys., Vol. 24, No. 7, 526-7 (Oct., 1956).

Standard procedures are used to derive the six types. They relate to solutions of the heat conduction equation or the wave equation. L.S.Goddard

518.4

2909. CURVE FITTING. L.E.Dunbar.
Amer. J. Phys., Vol. 24, No. 6, 464 (Sept., 1956).

A method for fitting a polynomial of degree n-1 to a set of n points, using a simplified algebraic technique which does not involve the solution of simultaneous equations. N.Corcoran

518.5

2910. SIMPLE ANALOG COMPUTER. C.Zucker.
Amer. J. Phys., Vol. 24, No. 6, 462 (Sept., 1956).

Describes a circuit for evaluating the expression $f_1 f_2/(f_1+f_2-d)$. Extensions may be made to the circuit, for instructional purposes. N.Corcoran

518.5 : 539.172.4 : 681.142 : 621.317.79

2911. AN ANALOGUE COMPUTER FOR NUCLEAR POWER STUDIES. G.J.R.MacLusky.
Proc. Instn Elect. Engrs, Paper 2337M, publ. March, 1957, 10 pp. To be republished in Vol. 104B (1957).

Describes a new analogue computer which has been constructed at the Atomic Energy Research Establishment. It comprises three main sections, namely the reactor-kinetics section, the control-system section and the thermal-system section. The design of these sections and their interconnection is described in detail, and brief reference is made to some of the problems which will be studied with this new computer. A.

518.5 : 537.213 : 621.317.729

THE ELECTROLYTIC TANK FOR THE ANALOGUE SOLUTION OF POTENTIAL PROBLEMS. See Abstr. 2153

518.6 : 512.831 : 517.514.3

2912. MULTILAYER PROBLEMS IN THE SPHERICAL HARMONICS METHOD. B.Davison.
Canad. J. Phys., Vol. 35, No. 1, 55-63 (Jan., 1957).

In applying the spherical harmonics method to multilayer problems it is necessary to invert certain matrices. It is shown, for the cases of plane and spherical symmetry, that these inverse matrices can easily be written down explicitly, so that there is no need for numerical matrix inversion. A

519.2

2913. ASYMPTOTIC DISTRIBUTION FOR THE χ^2 CRITERION. S.Kh. Tumanyan.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1011-12 (1954). In Russian.

The statistical significance of a particular set of sample measurements m_0, m_1 .... m_s on a population n is measured by the quantity χ^2 defined, in standard notation, by:

$$\chi^2 = \sum_{i=0}^{s} \frac{n}{p_i}\left(\frac{m_i}{n} - p_i\right)^2$$

The probability that $\chi^2 < x$ (positive definite) is denoted by F(x). The paper investigates the asymptotic behaviour of F(x) as $s \to \infty$, i.e. as larger and larger samples are taken, subject to various restrictions on the intrinsic probabilities p_i (e.g. some $p_i \to 0$). J.W.Gardner

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.113.3

2914. THE PROBLEM OF THE FRAME OF REFERENCE FOR STELLAR MOTIONS AND ITS ESSENTIAL CONNECTION WITH THE INVESTIGATION OF THE GALACTIC POTENTIAL. I. V.Nobile.
R.C. Accad. Naz. Lincei, Vol. 20, No. 6, 715-19 (June, 1956). In Italian.

General introductory paper.

522.25

2915. SERVO-MECHANISMS AND THE DESIGN OF LARGE TELESCOPES. P.B.Fellgett.
Occ. Notes Roy. Astron. Soc., Vol. 3, 143-59 (Feb., 1956).

Describes the application of servomechanisms to the driving and guiding of telescopes as an improvement on the present imperfect transmission through worm and gearing. Discusses methods of detecting the errors of guiding and correcting them. The use of these mechanisms to monitor the more complicated optical systems of large telescopes is discussed with the intention of relieving the observer of the work of guiding. It is stated that the difficulties arising in equatorially mounting large telescopes can be overcome by a symmetrical yoke mounting with servo drive in altitude and azimuth. This type is more compact than the equatorial mounting and requires a smaller dome to house it. The suggestion is that future large telescopes should be designed provided with motions which are approximate but which are optically controlled by servomechanisms. E.G.Martin

522.612

2916. DIELECTRIC INTERFERENCE FILTERS IN ASTRONOMICAL PHOTOGRAPHY. J.Ring.
Observatory, Vol. 75, 249-52 (Dec., 1955).

A survey of recently-developed techniques of producing efficient interference filters; and their rôle in astronomical observations. The use of such filters in nebular work can greatly diminish photographic fogging by the general sky background in long exposures, whilst transmitting freely the desired emission features. This effects a great gain of efficiency over conventional glass-filter combinations. D.R.Barber

522.612

2917. THE NEW CASSEGRAIN SPECTROGRAPH FOR THE MOUNT WILSON 60-INCH TELESCOPE. O.C.Wilson.
Publ. Astron. Soc. Pacific, Vol. 68, 346-50 (Aug., 1956).

The new spectrograph now in use with the 60 in. reflector has been designed to overcome the limitations of spectral range, lack of constancy of dispersion with wavelength, and small ratio of collimator focal length to camera focal length, inherent in previous designs.

Reflection gratings replace prisms in the dispersive train, three different rulings being available: (i) 10000 lines/inch, blazed in third order near 4200 A; (ii) 15000 lines/inch, blazed in third order near 3700 A to give bright second order near 5600 A, and bright first order near 11000 A; (iii) 15000 lines/inch, blazed in second order near 3500 A, with a bright first order near 7000 A. The instrument is provided with three Schmidt cameras of focal lengths, 4, 8, and 16 inches. Under average conditions the 4 in. lens will give measurable spectra of twelfth magnitude stars (with dispersion of 80 A/mm near 4200 A) for an exposure time of about 2 hours.

D.R.Barber

523.11

2918. THE ABUNDANCES OF THE CHEMICAL ELEMENTS IN THE GALAXY AND THE THEORY OF THEIR ORIGIN. J.L.Greenstein.
Publ. Astron. Soc. Pacific, Vol. 68, 185-203 (June, 1956).

A non-technical review of current numerical data of stellar, terrestrial, and meteoritic chemical abundances, and their implications in relation to the origin and evolution of the universe. A bibliography of 40 sources is appended. D.R.Barber

523.11

2919. ON ANISOTROPIC MODELS IN NEWTONIAN COSMOLOGY. G.Arrighi.
R.C. Accad. Naz. Lincei, Vol. 21, No. 1-2, 79-83 (July-Aug., 1956). In Italian.

Zagar's theory is extended to the case in which the ratios $\alpha_1 : \alpha_2 : \alpha_3$ are not necessarily independent of the time, the α's being the coefficients defining the nebular velocity field $v_i = \alpha_i x_i$. R.A.Newing

523.112 : 530.12

2920. THE SECOND-ORDER TERM IN THE REDSHIFT-MAGNITUDE RELATION. F.Hoyle and A.Sandage.
Publ. Astron. Soc. Pacific, Vol. 68, 301-7 (Aug., 1956).

It is noted that estimates from observational data of the constant q_0 occurring in the relation

$$m_{bol} = 5\log(c\Delta\lambda/\lambda) + 1.086(1 - q_0 - 2u)(\Delta\lambda/\lambda) + \text{const.}$$

make possible the determination of ρ and $\ddot{R}$ for exploding models of general relativity and distinguish between closed, Euclidean and hyperbolic models. It is also noted that q_0 is positive for these models, but is equal to -1 in the steady-state theory. R.A.Newing

523.164 : 621.396.67

2921. TWO-DIMENSIONAL AERIAL SMOOTHING IN RADIO ASTRONOMY. R.N.Bracewell.
Austral. J. Phys., Vol. 9, No. 3, 297-314 (Sept., 1956).

The visibility of a Fourier component of a two-dimensional temperature distribution which is scanned by certain kinds of rigid aerial is given by the normalized complex autocorrelation function of the field distribution over the aerial aperture (assuming that turning the aerial in its own plane is not allowed). Hence, for finite aerials, the visibility of the Fourier components falls to zero at finite values of spatial frequency. Consequently observations need only be made at certain peculiar intervals whose size is worked out. Interpolation between observations so spaced can be carried out by a method which then, by a simple extension, permits filtering of data which are to be freed from high spatial frequencies. Both interpolation and filtering are basic processes in the handling of two-dimensional data and contour maps in radioastronomy. The restoration of smoothed data is discussed from the viewpoint that only the simplest operations on extensive two-dimensional data are feasible, and details of a suitable technique of restoration are summarized. Application of further smoothing to existing data is shown to be important, and a method for doing it is given, again under the restriction to simple operations. The flux density of a source is shown to be given exactly by summing one in four of the isolated values observed at the peculiar intervals. A.

523.164.32

2922. THE SOLAR ECLIPSE OF JUNE 30, 1954 AS OBSERVED IN HELSINKI ON WAVE-LENGTH, 3.7 METRES. J.Tuominen, J.Riihimaa and K.Tuori.
Ann. Astrophys., Vol. 18, No. 3, 147-50 (1955).

Describes a radio phase-switching interferometer used on 3.7 m to measure the percentage of solar radiation received during the eclipse as a function of time. Results indicate that the visible solar disk was slightly brighter relative to the observations of O'Brien (1953). The corona was found to be brighter at the equator than at the poles. D.R.Barber

523.164.32

2923. CONTRIBUTION TO THE STUDY OF SOLAR RADIO-FREQUENCY STORMS. M.Jorand.
Ann. Astrophys., Vol. 18, No. 3, 180-7 (1955). In French.

Apparent altitudes of emission at the different observed frequencies have been determined from measurements of the direction of the radio-waves emanating from sunspot regions. The influence of turbulence in the coronal atmosphere on these results is discussed and compared with similar data obtained from observations of the occultation by the solar corona of the intense radio-source in Taurus. D.R.Barber

523.164.32

2924. RADIOFREQUENCY OBSERVATIONS OF THE TOTAL ECLIPSE OF THE SUN ON 30 JUNE 1954. P.Coupiac, M.Laffineur and B.Vauquois.
Ann. Astrophys., Vol. 18, No. 4, 271–8 (1955). In French.

The records were obtained at Hagaby, Sweden, on a frequency of 545 Mc/s. A detailed study of the systematic errors of observation was made and corrections for these were applied to the recorded intensities. Reduced curves are reproduced for this eclipse and for the partial eclipse observed at Meudon, France, on the same date for frequencies, 545 and 255 Mc/s. D.R.Barber

523.164.32 : 523.75

2925. ON THE ASSOCIATION OF SOLAR RADIO EMISSION AND SOLAR PROMINENCES. J.P.Wild and H.Zirin.
Austral. J. Phys., Vol. 9, No. 3, 315-23 (Sept., 1956).

Prominence cinematograms made in the years 1949-55 have been examined and compared with the solar radio records at 167 Mc/s. No close connection was found between limb events and radio events, but some eruptions were found to be associated with simultaneous radio burts. Three such cases are discussed in detail. The limb passages of large sunspots in 1949-55 were studied on both cinematograms and single exposure surveys with the view of finding a criterion for radio-noisy spots. It was found that spot groups showing looped prominences and downward streaming from the corona showed a marked tendency to produce radio-noise stroms. This result is ascribed to the fact that the seat of such storms must lie in the corona and in the presence of strong ordered magnetic field. A.

523.164.85

2926. DIURNAL VARIATIONS IN FORWARD-SCATTERED METEOR SIGNALS. C.O.Hines.
J. atmos. terrest. Phys., Vol. 9, No. 4, 229-32 (Oct., 1956).

The nature of the observational selection of particular meteor paths with the forward-scattering technique, using widely-spaced transmitters and receivers, is discussed statistically after a theory of meteor visibility developed by Hines (Abstr. 8451/1955) and Forsyth, Hines and Vogan (Abstr. 2261/1956). Figures give the predicted diurnal variation in count for a hypothetical meteor-shower with various radiant declinations, for two transmitter-receiver paths (Winnipeg–Suffield and Winnipeg–Churchill). Predictions are also made for random meteor counts, and there is good agreement with preliminary observations. The effect of off-beaming the aerials is also considered. M.W.Ovenden

523.164.85

2927. SOME FACTORS AFFECTING THE RADIO DETERMINATION OF METEORIC VELOCITIES. D.W.R.McKinley.
Naturwissenschaften, Vol. 43, No. 10, 221-2 (1956).

Systematic differences between photographic and radar meteor velocity determinations are to be expected because (i) the ionized trail at any moment has the form of a cone rather than a cylinder, and (ii) the radar observations of velocity are made over a shorter path length, which is, in general, towards the end of the photographic or visual path, and the velocity determination would thus be affected by atmospheric deceleration of the meteor. Velocity determinations by the two methods for the δ-Aquarid and Perseid showers are compared. It is concluded that any correction for systematic error in the radar determinations is unlikely to shift any significant proportion of the determined velocities above the hyperbolic limit. M.W.Ovenden

523.165 : 537.591.5

SOLAR COSMIC RAYS OF FEBRUARY, 1956 AND THEIR PROPAGATION THROUGH INTERPLANETARY SPACE. See Abstr. 2387

523.24 : 525.3

2928. A SOLAR HYPOTHESIS. G.Piccardi.
R.C.Accad. Naz. Lincei, Vol. 21, No. 1-2, 84-6 (July-Aug., 1956). In Italian.

The motion of the earth relative to the fixed stars is helicoidal

when allowance is made for the approximately uniform motion of the sun, the velocity of the earth being in its equatorial plane in March and approximately in the direction of the North polar axis in September. Attention is drawn to possible geophysical effects of this motion through the matter and magnetic fields of interstellar space.

R.A.Newing

523.34

2929. ORIGIN OF THE SURFACE STRUCTURE OF THE MOON. H.C.Urey.
Angew. Chem., Vol. 68, No. 17-18, 533-9 (1956). In German.

The apparent surface structure of the moon seems to bear witness to surface-moulding events having taken place relatively soon after the formation of the moon, which roughly coincides with the origin of the earth. The influences which had been of decisive importance are discussed, in the first place the chemical composition, collisions with satellites and formation of dust. F.Lachman

523.44

2930. APPROXIMATE CALCULATION OF THE ORBIT ELEMENTS OF A SMALL PLANET ON THE BASIS OF THREE HELIOCENTRIC POSITIONS. B.Popovich.
Period. math.-phys. astron. [Zagreb], Vol. 11, No. 1, 45-52 (1956). In Russian.

Describes a short method of calculating the vector elements involved, when an accurate calculation is either not required or not possible. The simplification is applied to the stage following the finding of the three heliocentric positions. The approximation consists in substituting a circle (defined by the heliocentric positions) for the orbit. Six vector elements calculated by this method for the (931) Whit(te)more planet agree well with data obtained by the accurate method. F.Lachman

523.5

2931. CRUCIAL EXPERIMENT CONCERNING THE ORIGIN OF METEORITES. S.F.Singer.
Phys. Rev., Vol. 105, No. 3, 765-6 (Feb. 1, 1957).

It is suggested that the $He^3 : He^4$ ratio of iron meteorites be measured after the samples have been heated. It is anticipated that the ratio will be greater than in corresponding unheated samples. Results of such experiments are of importance in dating the breakup of the meteorite's parent planet as well as for estimating the value of the prehistoric cosmic-ray flux. A.

523.67

2932. A STUDY OF THE INTENSITY-DISTRIBUTION OF THE $(A^3\Pi_g - X^3\Pi_u)$ SYSTEM OF C_2 EXCITED BY RADIATIVE RECOMBINATION. G.Lucas and R.Herman.
Ann. Astrophys., Vol. 18, No. 3, 211-31 (1955). In French.

It is shown that radiative recombination plays an essential role in producing emission of the Swan bands of C_2 in cometary spectra. To reconcile the high temperature ($\sim 3000^0$ K) deduced from the vibrational—rotational band-intensities, with the low temperature of the cometary nucleus ($\leq 273^0$ K) it is supposed that the C_2 molecules are partially ionized by shortwave solar radiation, with the formation of C_2^+ ions. The Swan bands are finally emitted by radiative recombination. D.R.Barber

523.7 : 523.164.32

2933. THE GENERAL MAGNETIC FIELD OF THE SUN. R.G.Conway.
Observatory, Vol. 76, 106-8 (June, 1956).

Radio observations of the degree of polarization of coronal radiation at a wavelength of 60 cm were made at Cambridge during June 1955 with a high-resolution interferometer in order to detect a coronal magnetic field. The results imply an upper limit to the field-strength for the lower corona which corresponds to a surface polar field-strength of 2.5 gauss. D.R.Barber

523.743

2934. GRANULATION OF THE SOLAR SURFACE. H.von Klüber.
Observatory, Vol. 76, 68-70 (April, 1956).

The use of a new grating ruled by H.W.Babcock, Mt.Wilson and Palomar Observatories, and blazed for the fifth order with a resolution of 600 000 at high intensity, in conjunction with the Cambridge (England) solar spectrograph, has revealed visually hitherto unnoticed spiky, or hair-like structures within the Fraunhofer lines, particularly in Hα. Emphasis is laid on the new field of solar study now opened up by these high-quality gratings. D.R.Barber

523.75

2935. SIMULATION OF SOLAR PROMINENCE IN THE LABORATORY. W.H.Bostick.
Phys. Rev., Vol. 104, No. 4, 1191-3 (Nov. 15, 1956).

An experiment is described in which plasma sources are suitably embedded in the poles of a strong horseshoe magnet (H = 2000 G at the poles) placed inside an evacuated chamber ($\sim 10^{-4} - 10^{-2}$ mm Hg) and a capacitor (0.06 μF) is discharged thereby producing a p.d. between the two sources with ejection of plasma. If the electrical connections are such that: (a) two sources are used, and the p.d. applied between them, or (b), one source only is used, and the magnet earthed, a current will flow through the ionized gas along the field-lines, giving rise to luminous filaments that arch between the magnetic poles and simulate prominence phenomena. The experiment suggests that the several filaments are acting as "plasma guides" i.e. the plasma projected by the source is actually following these filaments along the magnetic lines of force. D.R.Barber

523.752

2936. THE EFFECT OF ORIENTATION ON THE THICKNESS OF PROMINENCES. S.G.M.Haug.
Proc. K. Ned. Akad. Wetensch. B., Vol. 59, No. 2, 174-80 (1956).

The values for the line-of-sight thickness of some prominences derived from the intensity of the continuous spectrum and published in the Amsterdam Circulars 5a, 5b and 6, deviate from the mean thickness derived from dark filaments, given by D'Azambuja (6600km). Studying the dark filaments for the prominences in question from the "Cartes Synoptiques de la Chromosphère Solaire" (Meudon) an explanation is found in the orientation of the filaments, with respect to the line-of-sight, which during the eclipse are seen as bright prominences. A.

523.76

2937. NOTE ON THE INFLUENCE OF THE HELIUM AND METAL CONTENT ON THE PRESSURE IN THE SOLAR ATMOSPHERE. H.Hubenet.
Proc. K. Ned. Akad. Wetensch. B., Vol. 59, No. 3, 211-20 (1956).

New information is provided on the influence of the composition of the solar atmosphere on total gas pressure and electron pressure for a given temperature distribution, T, assumed to be valid for a given chemical composition, and to remain so when the composition is modified. D.R.Barber

523.77

2938. EMISSION OF CALCIUM IN THE SOLAR CORONA. M.N.Gnevȳshev and R.S.Gnevȳsheva.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 811-12 (1954). In Russian.

A brief summary of the evidence that the observations made on 31 March 1953 of the emission from the corona, identified the ionized Ca line at 6374.5 A in agreement with the hypothesis of Mustel' (1948). W.Bardsley

523.82 : 535.24

2939. TRADITIONAL ELEMENTS, PHOTOMETRIC REQUIREMENTS AND ASTRONOMICAL LIMITATIONS IN THE PROBLEM OF STELLAR MAGNITUDES. M.G.Fracastoro.
Atti Fond. Ronchi, Vol. 11, No. 3, 262-9 (May-June, 1956). In Italian.

An explanation is given of the logarithmic relation between visually estimated magnitudes and the luminous flux from stars, and of the associated limitations of the eye. The spectral sensitivity of the eye and other receptors, particularly the photographic plate, and the effects of transmission and reflection functions of optical components are discussed. The consideration of problems of colour and spectral energy distribution in stars leads to the conclusion that photographic determination of magnitudes should use a limited range of the visual spectrum; on the other hand the photographic recording of the ultraviolet emission is of importance in astrophysical, as distinct from statistical work on the stars. S.T.Henderson

523.852.3

2940. THE EFFECT OF A TYPE-II POPULATION ON THE REDDENING OF AN EXTRAGALACTIC NEBULA. E.Vandekerkhove.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 2, 185-200 (1956). In French.

From a consideration of the apparent evolution of the brighter stars characterizing both the photographic image, and spectrum of the nebula in the direction, type I ← type II, it is concluded that only a part of the reddening observed in distant nebulae arises from Doppler shift. The remainder is accounted for by a change in the composition of the nebula (with distance) towards the left of the Hertzsprung—Russell diagram. Thus for a group of extragalactic nebulae, having a common origin, the furthest objects will appear less evolved, and populated with stars which are redder than those in the nearer objects, leading to a spectral reddening of the same order of magnitude as that observed. D.R.Barber

523.877

2941. STELLAR PULSATION. I. MOMENTUM TRANSFER BY COMPRESSION WAVES OF FINITE AMPLITUDE. C.Whitney.
Ann. Astrophys., Vol. 19, No. 1, 34-43 (1956).

It is shown that the passage of compression waves of finite amplitude through a stellar atmosphere leads to an expansion, characterized by a reduction in the effective gravity. Graphical solution of the relevant hydrodynamical equations gives a value of the expansion factor which, for the star W Virginis, has a value of about 5. The same theory is applicable to a stellar model in which convective motions of the ionization zones generate sonic waves whose amplitude may become finite during outward propagation. D.R.Barber

523.877

2942. THE PULSATION OF A COMPOSITE ATMOSPHERE. E.Schatzman.
Ann. Astrophys., Vol. 19, No. 2, 45-50 (1956). In French.

The passage of progressive waves through a composite model atmosphere, consisting in a high-temperature isothermal layer above a low-temperature isothermal zone, has a damping effect on the natural period of oscillation of the model. The result is applied to the problem of pulsation in giant stars (see abstract following). D.R.Barber

523.877

2943. THE PULSATION OF A MODEL OF A RED-GIANT (STAR). E.Schatzman.
Ann. Astrophys., Vol. 19, No. 2, 51-70 (1956). In French.

The red-giant model of P.Curien (1954) yields pulsations of large amplitude in the surface layers outside of the convective zone. These regions thus play an important role in determining the stability of the stellar atmosphere. The model appears to be vibrationally unstable, but a definite answer to this problem can only be obtained by a detailed study of all the various processes at work in the surface layers. D.R.Barber

523.877

2944. A POSSIBLE CAUSE OF THE EJECTION OF MATERIAL BY LATE-TYPE GIANTS. F.Hoyle.
Astrophys. J., Vol. 124, No. 2, 482-4 (Sept., 1956).

To account for the observational evidence for the ejection of matter from the M-supergiant component of α Herculis (Deutsch, 1956), a stellar model is proposed which, although satisfying the usual condition of hydrostatic equilibrium, is nevertheless unstable since ionized H directly below the photosphere can acquire sufficient total energy to overcome the stellar gravitational field. In such cases, perturbations of the equilibrium model can lead to the ejection of material from the stellar surface out to infinity. It is shown that such a process will lead to a rate of loss of a mass which is of more importance in its effect on stellar evolution than nuclear processes. D.R.Barber

529.78 : 531.764

2945. SYNCHRONIZATION OF PENDULUM CLOCKS WITH THE HELP OF SIGNALS TAKEN FROM A QUARTZ-CRYSTAL CLOCK. M.v.Ments.
Amer. J. Phys., Vol. 24, No. 7, 489-95 (Oct., 1956).

A great number of good pendulum clocks have an accuracy of between $\pm$ 0.1 and $\pm$ 0.5 sec/day. This figure does not compare very well with the accuracy of a fairly good quartz-crystal clock, which can be of the order of 0.01 sec/day and better. Besides, setting a pendulum clock in the case that the difference in time is a fraction of its period, is rather tedious. A method will be described by which a pendulum clock is locked into synchronization, by energizing a pair of electromagnets (put at some critical places along the orbit of the pendulum) with special signals taken from a quartz-crystal clock. A.

PHYSICS 53

53 : 537.3.08

2946. TEACHING WITH THE POLYGRAPHE. M.G.Odier.
Amer. J. Phys., Vol. 25, No. 2, 51-7 (Feb., 1957).

Teaching physics with the aid of the Polygraphe, a recording milliammeter of great versatility, is a new teaching method rapidly developing in different French schools. In lecture demonstrations or in students' laboratory exercises this method provides graphs of great precision immediately usable for measuring purposes and for drawing curves of all sorts. In this paper, the psychological advantages of the Polygraphe as a teaching device are stated, and a few of its applications in elementary laboratory work are outlined. A.

53 : 535.39

2947. SUGGESTION REGARDING THE INTRODUCTION OF THE CONCEPT OF PHASE CHANGE FOR REFLECTED RADIATION. C.S.Cook.
Amer. J. Phys., Vol. 25, No. 2, 92-4 (Feb., 1957).

In the study of radiation reflected from a surface, the concept of phase change appears to many students as some sort of "black magic" when introduced following the derivation of the Fresnel equations. This, however, is the point at which the concept is first considered by many texts. It seems that by appropriate introduction of phase change into the derivation of the Fresnel equations, a clearer understanding of this concept may be gained. A.

53.08 : 621-5

2948. SOME PRINCIPLES OF MEASUREMENT AND CONTROL. J.F.Coales.
J. sci. Instrum., Vol. 33, No. 12, 457-64 (Dec., 1956).

Measurements can be divided into two broad classes: those which only have to be observed and recorded and those which are used to control sources of power in order to change some quantity such as position, speed, temperature or pressure. In both cases the principles are the same and there are certain limitations from which all measuring instruments suffer, e.g. they all disturb the physical system on which the measurements are being made and they all have inertia and damping to some degree. Also, no measuring instrument is completely stable and all exhibit unwanted fluctuations if the sensitivity is increased to the limit of usefulness. These limitations are discussed together with the principles underlying the design of measuring systems to reduce their effect to a minimum. The simple theory of linear control systems is developed and it is shown that the only real difference between measuring systems and control systems lies in the magnitude of the power required at the output. Negative feedback in a closed-loop system is shown to be the equivalent of the restoring force in an open-loop system. A.

FUNDAMENTALS 530.1

530.12

2949. RELATIVITY OF SIMULTANEITY IN A SINGLE GALILEAN FRAME. B.Liebowitz.
Amer. J. Phys., Vol. 24, No. 8, 587-8 (Oct., 1956).

Grünbaum (Abstr. 9404/1955) defines clocks at A and B to be synchronous if $t_B = t_A + \epsilon(t'_A - t_A)$, $0 < \epsilon < 1$, t_A, t'_A being the times of emission of a signal at A and of its return to A, and t_B the time of reflection at B. It is here maintained that ϵ must have the Einsteinian value of $\frac{1}{2}$ since recent measurements by cavity resonators of the one-way speed of light in free space show it to be constant and isotropic. These measurements are local, and therefore independent of definitions of simultaneity at separated points. Further confirmation of the value $\epsilon = \frac{1}{2}$ follows from experimental determination of the ratio of the e.m. and e.s. units of charge, this ratio giving the value of the one-way speed of light. R.A.Newing

530.12

2950. RELATIVITY OF SIMULTANEITY WITHIN A SINGLE GALILEAN FRAME. A REJOINDER. A.Grünbaum.
Amer. J. Phys., Vol. 24, No. 8, 588-90 (Oct., 1956).

Liebowitz's claim that a physical description based on a value of $\epsilon \neq \frac{1}{2}$ must be false is rejected. It is maintained that the convention $\epsilon = \frac{1}{2}$ is implicit in the use of the local frequency of the transmitter in the calculation of the one-way speed of light in cavity resonator experiments. It is further claimed that this convention is also implicit in the electromagnetic equations, and that the equations would be different for a different choice of ϵ. R.A.Newing

530.12 : 535.233

2951. CONTRIBUTION TO MILNE'S PROBLEM IN THE CASE OF A GREY BODY. J.Warzée.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 6, 703-20 (1956). In French.

The two equations of condition can be written in the form,

$1/2\ A_0 + \sum_{m=2}^{\infty} J_{2m}A_m - 1/3 = 0$; and,

$1/2\ J_{2n}A_0 + \sum_{m=2}^{\infty} (J_{mn} - P_{mn})A_m - 1/2\ J_{2n} = 0$, where $n = 2,3,4 \ldots$,

$J_{mn} = \int_0^{\infty} E_m(\tau)E_n(\tau)d\tau$, and $P_{mn} = \int_0^{\infty} \lambda_m(\tau)E_n(\tau)d\tau$,

with $\lambda_m(\tau) = \Lambda_\tau[E_m(t)]$. Using tables of the integrals, J_{mn} and P_{mn}, both equations can be solved numerically to yield results more accurate than those obtained by other methods. The fourth successive approximation gives the source-function, $B_i(\tau)$, to an accuracy of 0.001%, and the darkening-function, $I_i(0,\mu)$, with an error of only 0.0004% at the origin, and less than 0.000 05% over the greater part of the interval $0 \leq \mu \leq 1$. D.R.Barber

530.12

2952. GEODESIC LINES FOR AN ELLIPSOID IN NON-EUCLIDIAN SPACE. D.Mordukhaĭ-Boltovskoĭ.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 991-3 (1954). In Russian.

The geodesic equations are obtained directly by minimizing the action integral with the metric tensor appropriate to the Talhausen (ellipsoidal) universe. J.W.Gardner

530.12

2953. CONSERVATION LAWS AND OTHER IDENTITIES IN BONNOR'S UNIFIED FIELD THEORY. S.I.Husain.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 768-78 (Oct., 1956).

The field equations of the unified field theory, given by W.B.Bonnor (Abstr. 709/1955) are considered and the conservation laws in the field have been studied. The paper has been divided into two parts, in the first of which the invariant and non-ivnariant forms of conservation laws have been studied, and in the second part an alternative procedure analogous to that adopted by Schrödinger in his purely affine fields has been sketched. It has been shown that the conservation laws which hold in Schrödinger's and Einstein's field also hold in the present case. The momentum–energy tensors in this case have been shown to satisfy sixteen identities which are seen to be akin to those obtained by Schrödinger. A.

530.12

2954. BASIC PRINCIPLES OF UNIFIED FIELD THEORY. R.S.Mishra.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 907-16 (Oct., 1956).

In this paper the basic principles of Einstein's, Schrödinger's and Bonnor's unified field theory have been studied. Originally the field equations were given in terms of contracted curvature tensor $R_{\mu\lambda}$. Here the relations are obtained between $R_{\mu\lambda}$ and some other tensors like Einstein's tensor, transposed tensor and the tensor $T^{\alpha}_{\beta[\gamma\alpha]}$, and the field equations are modified in terms of these tensors. It has been shown how these tensors are obtained in a number of ways in Ricci identities when the covariant differentiations are performed taking into consideration the nature of the indices. A.

530.12

2955. PHENOMENOLOGICAL APPROACH TO A UNIFIED FIELD THEORY. R.L.Arnowitt.
Phys. Rev., Vol. 105, No. 2, 735-42 (Jan. 15, 1957).

An attempt is made to give a phenomenological approach to a unified field theory by imposing four restrictions based on known experimental and theoretical considerations. The first two criteria, namely, that for weak electromagnetic fields the unified equations obey the flat space principle of conservation of energy and that the first-order corrections to Maxwell's equations do not violate known experiments concerning the electron, lead to the requirement that a microscopic length appear in the Lagrangian. The remaining two conditions are a correspondence principle constraint for determining the form of the affinity and a gauge invariance condition. These four restrictions lead to a Lagrangian. The gauge invariance requirement forces the existence of a cosmological term. The field equations have been investigated for the spherically symmetric static solutions around a point electron. They lead to finite Coulomb energies, the microscopic length acting as the cut-off parameter. A.

530.12

2956. A UNIFIED THEORY OF GENERAL RELATIVITY OF GRAVITATION AND ELECTROMAGNETISM. II-III. L.P.Eisenhart.
Proc. Nat. Acad. Sci. U.S.A., Vol. 42, No. 9, 646-50 (Sept.); No. 11, 878-81 (Nov., 1956).

The previous theory (Abstr. 68/1957) is modified by taking the coefficients of connection Γ^i_{jk} to be $\{^i_{jk}\} + a^i_{jk}$, where $a^i_{jk} = \lambda^i F_{jk}$ in II, and $\lambda^i g_{jk}$ in III. Among the possible field equations in III are the familiar equations $R_{jk} = F_{ji}F^i_k - \frac{1}{4}g_{jk}F_{ih}F^{ih}$. R.A.Newing

530.12 : 532.5 : 538.3

2957. ELECTRODYNAMICS AND HYDRODYNAMICS IN [FANTAPPIÈ'S] DEFINITIVE RELATIVITY. G.Arcidiacono.
R.C. Accad. Naz. Lincei, Vol. 20, No. 5, 616-22 (May, 1956). In Italian.

It is shown that, if the 5-space bivector field G_{ik} (see Abstr. 42/1956) is subject to the condition $\bar{G}_{ik} = G_{ik}$, the field equations separate in the relativistic limit into the classical electromagnetic equations together with a set of equations defining the relativistic motion of an incompressible perfect fluid. R.A.Newing

530.12 : 531.51

2958. ON THE EQUATIONS OF MOTION OF FINITE MASSES IN THE GENERAL THEORY OF RELATIVITY. M.F.Shirokov and V.B.Brodovskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1027-33 (1956). In Russian.

An approximate theorem (neglecting gravitational radiation, etc.) pertaining to the motion of the centres of inertia of bodies along geodetic lines in gravitational fields of other bodies, considered as points, is proved for a system of astronomical bodies on the basis of the general relativity centre-of-mass theorem and equivalence principle. This theorem expresses the laws of motion of finite masses in general relativity. Proceeding from it the relativistic equations of motion of a system of n bodies have been comparatively simply deduced; to accomplish this it was sufficient to insert only the second approximation of the solution of the gravitation equations obtained by Einstein into the geodetic line equation. The equations thus obtained are identical with the equations of motion obtained by more complicated means from the condition of solvability of the gravitation equations in the third approximation. The theorem reveals the cause of equivalence of investigations based on different concepts regarding the bodies of the system as finite or point masses and indicates the significance of the equivalence principle in Einstein's general theory of relativity. A.

530.12 : 531.51

2959. ON GRAVITATIONAL MOTION. B.Bertotti.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 898-906 (Oct., 1956).

The problem of gravitational motion can be fruitfully tackled by using an alternative perturbation method, in which the "quasi-stationary" assumption is replaced by a more general one, fast motion being allowed, although the field is still weak. A simple rigorous property of spherical symmetry is assumed for each body, which is described by a suitable distribution of energy and momentum. The equations of motion which one obtains for the two-body problem at the first approximation are nothing but Einstein's equations, except for the two terms which are nonlinear in the masses. A.

530.12

2960. ETHER DRIFT AND GRAVITATIONAL MOTION. G.Szekeres.
Phys. Rev., Vol. 104, No. 6, 1791-8 (Dec. 15, 1956).

In a previous paper (Abstr. 1497/1955) the formalism of general relativity was extended so as to include the notion of a physically meaningful universal cosmic time. The present paper deals with the field of a body in absolute motion and the related problem of gravitational motion in the presence of ether drift. It is shown by the method of Infeld and Schild that the path of a free particle is geodesic provided that its absolute velocity is small compared with the velocity of light; for photons and high-velocity particles, however, the results are inconclusive. Although the ether drift is thus shown to have no direct effect upon the motion of a (slow) particle, it nevertheless influences the motion indirectly as it modifies the external field and the geodesics themselves. This is clearly demonstrated in the case of the field generated by a centrosymmetrical body, which loses some of its symmetry through the action of ether flow; the resulting asymmetry makes it possible to detect and measure the ether drift vector $-\partial\tau/\partial x_m$ experimentally. The effect is small, of about the same order of magnitude as the general relativistic corrections of Newtonian theory; by asses-

sing the available observational data it is concluded that the velocity of ether drift in the solar system, as understood in this theory, is probably less than 100 km/sec. A.

530.12 : 531.18

2961. ACCELERATED SPHERICAL LIGHT WAVE CLOCKS IN CHRONOGEOMETRY. A.D.Fokker.
Proc. K. Ned. Akad. Wetensch. B., Vol. 59, No. 5, 451-4 (1956).

A rigid spherical mirror, at the centre of which a light pulse has been started, is taken as a model clock. By considering reflections at the extremities of the diameter parallel to the acceleration, it is shown that successive reflections and focusing of the pulse will not be disturbed by the accelerated motion $x = r.\cosh\psi$, $ct = r.\sinh\psi$, reflections occuring when $\psi = n\psi_1$ and focusing when $\psi = (n + \frac{1}{2})\psi_1$, n being an integer. It is concluded that infinitesimal spherical light wave clocks will not be disturbed by any nonuniform acceleration. R.A.Newing

530.145

2962. ISOTOPIC INVARIANCE AND CREATION OF PARTICLES. L.I.Lapidus.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 865-75 (1956). In Russian.

Conclusions which can be drawn from the law of conservation of isotopic spin are investigated. An examination of meson production processes yields relationships between cross-sections which are valid when states with definite meson and nucleon isotopic spin values are predominant in the meson–nucleon interaction. The Smorodinskii–Jacobsohn relation for elastic n–n interaction is extended to the case of meson pair and nucleon–antinucleon pair production. Consequences of isotopic invariance have been deduced for processes of meson formation on nuclei, creation of heavy meson pairs and nucleon–antinucleon pairs in π–n collisions and also for some annihilation processes in n–d collisions. A.

530.145 : 534.2 : 538.566

HIGH-FREQUENCY SCATTERING. See Abstr. 2446

530.145

2963. ON DISTRIBUTIONS IN REPRESENTATION SPACE. R.L.Stratonovich.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1012-20 (1956). In Russian.

The concept of distribution in representation space is introduced. This permits one to obtain a quantum generalization of the theory of correlated random points. The general formulae are applied to the special case of distributions in phase space and angular spin distributions. A.

530.145

2964. QUANTUM FIELD THEORY AS DISTRIBUTION THEORY. W.Schmidt and K.Baumann.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 860-86 (Oct., 1956). In German.

An attempt to utilize the theory of distributions due to L.Schwartz in the quantum theory of free fields. Many formulae of the conventional scheme can be taken over subject to only minor modifications. P.T.Landsberg

530.145

2965. ON COVARIANT QUANTIZATION WITH APPLICATION TO THE SCATTERING OF GRAVITATING DIRAC PARTICLES. B.E.Laurent.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1445-60 (Dec., 1956).

The action method of Feynman (Abstr. 3107/1948) and Matthews and Salam (Abstr. 7682/1955) is used. It seems to be easy thus to quantize in a generally covariant way merely using the whole invariant Lagrangian without subsidiary conditions. It is shown that such a procedure leads to the ordinary quantization in the electrodynamic case. The Lagrangian for the Dirac field is developed in powers of $\beta = \sqrt{2K}$, where K is the Einstein gravitation constant. The same is done with the usual Lagrangian for the gravitation field, as has been proposed by Gupta (Abstr. 3267, 7920/1952). The simplest problem of two identical Dirac particles scattered against each other without radiation corrections is solved. A.

530.145

2966. ON THE VANISHING OF THE INTERACTION HAMILTONIAN. J.M.Cook.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1585-6 (Dec., 1956).

The conclusion reached by Landau and by Pomerančuk (Abstr. 6385/1956) that point interaction in quantum field theory produces no physical interaction is here derived from simpler considerations. P.M.Davidson

530.145

2967. ON QUASICLASSICAL QUANTIZATION. V.S.Kudryavtsev.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 688-92 (1956). In Russian.

A method of calculating energy levels by quasiclassical quantization is presented for the one-dimensional case. The energy values are expressed as an expansion in terms of $\hbar$. From certain assumptions, relating to the shape of the potential energy U (x) the expansion can be obtained in a general form. Calculations for the potential energy with a minimum, that is of the oscillator type, have been carried out. A.

530.145

2968. ONE-TIME FORMULATION OF THE RELATIVISTIC TWO-BODY PROBLEM. SEPARATION OF ANGULAR VARIABLES. W.Królikowski and J.Rzewuski.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 975-90 (Nov., 1956).

The separation of angular variables in the relativistic one-time equation for the two-fermion problem in quantum electrodynamics is carried out for the case of one-quantum interaction. The momentum representation is used. A system of sixteen integral equations with respect to one variable is obtained. This system reduces to four equations in the case $j = 0$ and to eight equations for $j \neq 0$. A.

530.145

2969. ELECTRODYNAMICS OF CHARGED SCALAR PARTICLES. L.P.Gor'kov and I.M.Khalatnikov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1062-78 (1956). In Russian.

The behaviour of the Green functions in the region of large momenta in electrodynamics for zero-spin charged particles has been investigated on basis of the Kemmer formalism. A.

530.145

2970. ANALYTICAL SOLUTION OF THE COVARIANT MESON NUCLEON INTEGRAL EQUATION. I.E.McCarthy.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 991-1008 (Nov., 1956).

The covariant integral equation for meson scattering in the $T = \frac{3}{2}$ state is investigated by the Fredholm method. Assuming that the zeros of the Fredholm denominator give resonances in the scattering cross-sections, the known resonance is accounted for using $G^2/4\pi = 14.1$. The experimental cross-sections are fitted reasonably well when radiative corrections are accounted for by a numerical factor in the low-energy approximation, and discrepancies are accounted for qualitatively. A.

530.145

2971. QUANTUM EFFECTS IN THE INTERACTION BETWEEN ELECTRONS AND HIGH-FREQUENCY FIELDS. VACUUM FLUCTUATION PHENOMENA. I.R.Senitzky.
Phys. Rev., Vol. 104, No. 5, 1486-91 (Dec. 1, 1956).

A calculation of dispersion caused by vacuum fluctuations in the velocity of an electron passing through a cavity, when performed by conventional methods, leads to a divergent result. This divergence is due to first-order coupling between electron and free-space radiation field. A unitary transformation is used to eliminate this coupling and still retain first-order coupling with a radiation field which differs from the free-space field, since the latter coupling is needed to discuss electron interaction with a cavity. With the transformed Hamiltonian, equations of motion are derived, and from these, the expectation value of the velocity increment and the dispersion of velocity are obtained. The former is the same as that obtained with the conventional Hamiltonian, but the latter is now given by a convergent result. A.

530.145

2972. PION EFFECTS ON FERMI INTERACTIONS. M.Ross.
Phys. Rev., Vol. 104, No. 6, 1736-40 (Dec. 15, 1956).

Fermi interactions are examined from the standpoint that the interaction between bare nucleons and light fermions may have simple form. The relation of this proposal to the usual expression of Fermi interactions in terms of physical nucleons is evaluated. This relation is specified fairly definitely by current meson theories for allowed β-decay processes. The possibility of a simple universal Fermi interaction and the relation of associated allowed and forbidden β-decay matrix elements are examined. Although some interesting conclusions can be drawn in these cases, the effects do not appear observable at the present time. A.

530.145

2973. INTERACTION OF P- AND S-WAVE PIONS WITH FIXED NUCLEONS. H.Miyazawa.
Phys. Rev., Vol. 104, No. 6, 1741-6 (Dec. 15, 1956).

A method is given of replacing pion scattering parts in a

Feynman diagram by experimentally observed quantities. In this paper momenta of nucleons are neglected, although nucleon pair creation is not. It is assumed that only P- and S-wave pions interact with nucleons. No interaction is assumed between pions. Two examples are given: (1) The anomalous magnetic moment of the proton is rigorously expressed in terms of pion–nucleon scattering amplitudes, or, alternatively, in terms of the renormalized coupling constant and the total cross-sections for pions. (2) The internucleon potential is also expressed by means of scattering quantities. In this case the number of virtual pions exchanged between the two nucleons is limited to two, although the number of pions emitted and absorbed by the same nucleon is not limited. A.

530.145

2974. SLOWING DOWN OF HIGH-ENERGY ELECTRON–POSITRON PAIRS BY IONIZATION. V.B.Berestetskiĭ and B.V.Geshkenbeĭn.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 722-3 (1956). In Russian.

The formula for the ionization produced by a very high energy pair, where the electron and positron will be very nearly parallel, is derived in quantum theory. G.E.Brown

530.145

2975. CONTRIBUTION TO THE THEORY OF NONLOCAL INTERACTION. V.S.Barashenkov.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 837-41 (1956). In Russian.

A possibility of Hamiltonian formalism in the theory of nonlocal interaction is considered. The Pauli method was examined for the special case of a one-dimensional oscillator. Initial integro-differential equations of motion and a canonical system of equations of motion obtained by the Pauli method are not equivalent. The Hayashi procedure was found to be inconsistent in any arbitrary approximation. This confirms the conclusion that the nonlocal interaction theory is of an essentially non-Hamiltonian nature. A.

530.145

2976. ESTABLISHMENT OF THERMAL EQUILIBRIUM BETWEEN QUANTA AND ELECTRONS. A.S.Kompaneets.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 876-85 (1956). In Russian.

Role of the Compton effect in establishment of thermal equilibrium between quanta and electrons is investigated in a nonrelativistic approximation. A.

530.145

2977. QUADRUPLE FIELDS. A.Aymard.
C.R. Acad. Sci. (Paris), Vol. 243, No. 13, 885-8 (Sept. 24, 1956). In French.

Field equations are derived from a variational principle, the Lagrange density being a function of the components and derivatives of an orthonormal set of four 4-vector fields in Riemannian space–time. R.A.Newing

530.145

2978. THE EQUATIONS OF THE MAGNETIC ELECTRON DEDUCED FROM THE THEORY OF QUADRUPLE FIELDS. A.Aymard.
C.R. Acad. Sci. (Paris), Vol. 243, No. 17, 1198-201 (Oct. 22, 1956). In French.

A physical interpretation is given for the terms in the Lagrange density (see preceding abstract) and a geometrical representation is obtained for the energy relation $W = h\nu$. R.A.Newing

530.145

2979. NUMERICAL ANALYSIS OF A UNITARY PARTICLE MODEL. F.A.Kaempffer and E.M.Kennedy.
Canad. J. Phys., Vol. 35, No. 1, 48-54 (Jan., 1957).

A classical unitary field model describing a family of electrically uncharged heavy particles is analysed numerically. A reasonable mass spectrum is obtained. Limitations of the model are stated. A

530.145

2980. THE STRUCTURE OF ELEMENTARY PARTICLES. Ya.P.Terletskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 2, 209-12 (1954). In Russian.

An attempt to give phenomenological systematics of elementary particles. Four types of fundamental "charges" of both signs (which might be compared to electric or nuclear "charges") are assumed to contribute to the formation of elementary particles according to conservation, combination and selection rules deduced by investigating the properties of the better-known particles. The properties of recently discovered heavy mesons are in agreement with this scheme, which should allow also the prediction of the existence and some properties of new ones. G.Martelli

530.145

2981. BILOCAL FIELD THEORIES AND THEIR EXPERIMENTAL TESTS. I. J.Rayski.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1231-41 (Dec., 1956).

Two versions of bilocal field theory are presented, one of them assuming the existence of an isospace, the other assuming a particle structure in the usual space. In the first version isospin is a primary concept whereas in the second it is interpreted as a "relative spin". In both formulations a very natural systemization of particles into four families is obtained: bosons–isobosons, bosons–isofermions, fermions–isobosons, and fermions–isofermions. The difficulty with higher states of charge is avoided. The problem of mechanical mass and field mass is discussed and arguments are given in favour of the opinion that (the main part of) the heavy particle mass is not a field mass. The formalism yields families of particles with increasing masses. The theoretical mass spectra agree remarkably well with experiment. The probability of an accidental coincidence of experimental and theoretical mass values is only 1/900. A.

530.145

2982. DIMENSIONALITY OF CHARGE SPACE. D.C.Peaslee.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1583-4 (Dec., 1956).

Though there is no lack of experimental evidence to indicate that real space–time is a four-dimensional manifold, there is much less certainty in attributing dimensions to the charge space of heavy particles. Various hypothesis are reviewed. P.M.Davidson

530.145 : 539.153.4

2983. PROTON STRUCTURE AND THE HYPERFINE SHIFT IN HYDROGEN. A.C.Zemach.
Phys. Rev., Vol. 104, No. 6, 1771-81 (Dec. 15, 1956).

The effect of the electromagnetic structure of the proton upon the hyperfine splitting of s states in hydrogen is determined without recourse to any specialized model for proton interactions. The principal modification of the Fermi formula, derivable nonrelativistically, appears as a multiplicative correction $1-2a_0^{-1}\langle r\rangle_{em}$ where a_0 is the Bohr radius and $\langle r\rangle_{em}$ is the first statistical moment of a distribution which characterizes the proton structure. The absence of additional structure corrections of experimental consequence is rigorously demonstrated. The method relies on a phenomenological representation of the proton deduced from the invariance principles of quantum field theory. The size of the proton is estimated from the available bound state data and compared with the size prediction inferred from scattering experiments. A.

530.145

2984. NUCLEON STRUCTURE IN THE STATIC THEORY. G.Salzman.
Phys. Rev., Vol. 105, No. 3, 1076-83 (Feb. 1, 1957).

The static theory of Chew and Low is used to calculate the form factors for the charge and current of the proton. The cross-section obtained with these form factors is found to be in close agreement with the electron–proton scattering data of McAllister and Hofstadter up to 236 MeV. Root-mean-square radii of 6.5×10^{-14} cm for the charge and 9.7×10^{-14} cm for the current are found. The role of an extended core charge is discussed. The value of the coupling constant used is $f^2=0.08$. A.

530.145

2985. CONVERGENT APPROACH TO THE THEORY OF ELEMENTARY PARTICLE INTERACTIONS. I.E.Segal.
Proc. Nat. Acad. Sci. U.S.A., Vol. 42, No. 11, 670-6 (Nov., 1956).

An abstract theory is given whose results are as yet only qualitative but which is nevertheless encouraging in view of the present state of knowledge about elementary particles. It appears that a logically complete and fundamentally simple theory may be based on the formulation of elementary particles essentially as group representations and that mathematical divergences may be eliminated simultaneously with physically nonoperational features. A.

530.145 : 539.18

2986. DEVELOPMENT OF THE THEORY OF ANTIPARTICLES, CHARGES OF ELEMENTARY PARTICLES AND THE PROPERTIES OF HEAVY NEUTRAL MESONS. Ya.B.Zel'dovich.
Uspekhi fiz. Nauk, Vol. 59, No. 3, 377-98 (1956). In Russian.

A historical survey of the above topics. 47 refs. (30 Soviet), all since 1948. C.R.S.Manders

530.145

2987. ON A RATIONAL SYSTEM OF SYMBOLS FOR ELEMENTARY PARTICLES. Ya.P.Terletskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 703-4 (1956). In Russian.

530.145

2988. STUDY OF CLASSICAL SCATTERING THEORY. M.M.Gordon.
Amer. J. Phys., Vol. 25, No. 1, 32-7 (Jan., 1957).

The classical theory of the scattering by a conservative central force is re-examined. A variational equation and a Fourier series expansion are developed whereby approximate expressions for the trajectory can be obtained. In addition, impulse integral equations are derived from which approximate relations between energy, impact parameter, and scattering angle can be developed. These methods are applied to potentials of the form $V = C/r^n$ and the results are found to be quite superior to those from the widely used small-angle approximation. A.

530.145

2989. ON THE DIVERGENCE SERIES OF PERTURBATION THEORY IN QUANTUM ELECTRODYNAMICS. B.L.Ioffe.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 437-8 (1954). In Russian.

Proposes an analytical alternative to Feynman diagrams for constructing the scattering matrix. The divergencies are handled in a self-consistent, physically meaningful way, and the equivalence with the Feynman diagram method is demonstrated. Application of the present technique to the meson theory is briefly discussed. J.W.Gardner

530.145

2990. SCATTERING IN FIELD THEORY. H.Ekstein.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1017-58 (Nov., 1956).

A precise statement of the scattering problem, general enough to include composite particles in field theory, is proposed: the four Heisenberg operators P_μ which represent the total energy–momentum vector, can be expressed asymptotically ($t \to \pm\infty$) as integrals of mutually commuting operators $A_r^{\pm\dagger}(k)k_r{}_\mu A_r^{(\pm)}(k)$ which represent the four-momenta of the incident and outgoing particles, both elementary and composite. For a theory given in terms of bare-particle creation operators $a_r^\dagger$, the problem consists in finding the asymptotic operators $A^{(\pm)}$ as functions of the a_r and $a_r^\dagger$. A system of linear equations for this purpose is derived. Alternatively, the S-matrix can be obtained by solving a bi-linear equation, the inhomogeneous term of which consists essentially of products of one-particle state vectors. A.

530.145

2991. PION THEORY OF NUCLEAR FORCES AND n–p POLARIZATION. J.Iwadare, S.Otsuki, R.Tamagaki and W.Watari.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1204-6 (Nov., 1956).

The no-recoil meson theoretic potential, which fits low-energy data well, is found not to give correctly the polarization in n–p scattering at 98 MeV. Polarization experiments at lower energies are recommended; it is suggested that polarization should be observable at 40 MeV. J.S.Bell

530.145

2992. BINDING ENERGIES OF THE LIGHT HYPERFRAGMENTS. J.T.Jones,Jr and J.M.Keller.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1329-38 (Dec., 1956).

The purpose of the present paper is to determine the constants of a phenomenological potential assumed for the Λ^0–nucleon interaction by fitting them to the observed binding energies of the mass 3 and 4 hyperfragments. Variational calculations have been carried out for these hyperfragments and hyperhelium-5. The calculations indicate that the Λ^0–nucleon force is strongly spin-dependent, and also that the hypertrineutron and hyperhelium-3 are not bound. The chief assumptions that have been made are: (a) the spin of the Λ^0 is $\frac{1}{2}$; (b) the hyperdeuteron is not bound; (c) the Λ^0–nucleon interaction arising from the virtual exchange of heavy mesons may be presented by the assumed phenomenological potential (any possible pion admixture resulting from the virtual exchange of at least two pions between the Λ^0 and nucleon being neglected); (d) all but the principal S-states of the hyperfragments with mass numbers less than or equal to five may be neglected; (e) the nucleon–nucleon interaction is represented by the central Yukawa interaction. The last three assumptions are rather severe and imply that the present calculations are to be considered as preliminary to a more complete investigation, in which the tensor interaction between nucleons and also the pion admixture of the Λ^0–nucleon force are included. A.

530.145

2993. BOUNDARY VALUE TREATMENT OF NUCLEON–NUCLEON PHASE SHIFTS. A.M.Saperstein and L.Durand, III.
Phys. Rev., Vol. 104, No. 4, 1102-13 (Nov. 15, 1956).

The phase-shift fits of Feshbach and Lomon (Abstr. 4204/1956) to the nucleon–nucleon scattering data in the energy range $0 \le E \le 274$ MeV are examined in detail. An attempt is made to improve the agreement with experiment, and the limitations of the Feshbach–Lomon fits are brought out. It is not found possible to obtain agreement with the data at all energies, even if all previously omitted phase shifts for $L \le 3$ are included. An independent fit to the proton–proton data is then developed by a boundary value method similar to that used by Breit and Bouricius, and a set of phase shifts for $L \le 4$ is found which fits the proton–proton cross-section and polarization throughout the energy range $0 \le E \le 310$ MeV. There seems to be no major obstacle to using the proposed p–p fit as the basis for a charge-independent fit to all the nucleon–nucleon scattering data. A.

530.145

2994. CONSTRUCTION OF THE ADIABATIC NUCLEAR POTENTIAL: FORMALISM. A.Klein and B.H.McCormick.
Phys. Rev., Vol. 104, No. 6, 1747-57 (Dec. 15, 1956).

A new formalism is presented for the construction of the two-nucleon potential, whose salient characteristic is that it involves an expansion only in the number of mesons exchanged, the self-mesonic field of each nucleon being treated, in principle, exactly. Access to the potential is achieved through the intermediary of the scattering matrix. With the assumption that nonlinear meson propagation may be neglected, alternative versions of this matrix are derived, only one of which is exploited in this paper. The connection between the scattering matrix and the potential is discussed, and it is emphasized again that the transition between the two requires a knowledge of non-energy-conserving matrix elements of the potential, which can be obtained only if the underlying Schrödinger equation is known. The potential involving the exchange of at most two P-wave mesons is computed and shown to depend on the renormalized coupling constant, the single-nucleon source function, and the total cross sections for pion-nucleon interaction. The numerical evaluation of these formulae is not attempted. A.

530.145

2995. INTEGRAL EQUATIONS FOR THE TRANSITION MATRICES IN THE STATIC MESON THEORY. N.Fukuda and J.S.Kovacs.
Phys. Rev., Vol. 104, No. 6, 1784-90 (Dec. 15, 1956).

The Chew–Low–Wick integral equation for the scattering matrix in the static meson theory has been generalized so as to make it possible to treat the various pion processes in which arbitrary numbers of pions are involved. Such a generalization is also necessitated if one wants to take into account the contribution of two- or more-meson configurations in pion–nucleon scattering. The outgoing or incoming wave-functions corresponding to the many-meson initial states are defined in the same manner as by the above-mentioned authors in the one-meson problem, and are shown to be identical with those introduced by Lippmann and Schwinger. An approximate expression for the two-meson production matrix is obtained and some correction terms due to this production are derived for the Chew–Low one-meson equation. A.

530.145

2996. PION-DEUTERON SCATTERING IN THE IMPULSE APPROXIMATION. R.M.Rockmore.
Phys. Rev., Vol. 105, No. 1, 256-64 (Jan. 1, 1957).

The pure-scattering model of Fernbach, Green and Watson is used to obtain impulse approximation expressions for the elastic, elastic plus inelastic (closure approximation), and charge-exchange (closure approximation) π–d differential cross-sections. The net interference where p-wave scattering is dominant is found to be constructive; the interference due to charge exchange scattering is always negative. The Coulomb effect gives rise to strong destructive interference in the π^+–d elastic component at 85 MeV (laboratory energy of incident pion) for angles $< 45^\circ$. The multiple-scattering correction as calculated on Brueckner's model is approximately 10% of the free particle cross-section and positive. However, a perturbation field-theoretic treatment of the (3/2, 3/2) double scattering indicates that Brueckner's model is unreliable at low energies. The binding correction to the impulse approximation is calculated using a p-state interaction Hamiltonian (PV coupling) and found to be −3.2 mb at 85 MeV. The forward peak in the elastic differential cross-section is found appreciably reduced by destructive interference arising from elastic "absorptive" scattering. It is concluded that, at energies $<\sim$ 100 MeV, absorption corrections are significant, with the multiple-scattering correction becoming important at higher energies. A.

530.145

2997. CALCULATION OF PHENOMENOLOGICAL NUCLEON–NUCLEON POTENTIALS. J.L.Gammel, R.S.Christian and R.M.Thaler.

Phys. Rev., Vol. 105, No. 1, 311-19 (Jan. 1, 1957).

An attempt to find a phenomenological nucleon—nucleon potential is described. The class of charge and velocity independent potentials with central and tensor parts of Yukawa shape with a hard core is considered. The depths, ranges, and core radii of such potentials with general spin and parity dependence are adjusted to fit experimental data. No potential of this type is found which fits all of the data. A.

530.145

2998. ISOTOPIC SPIN AND ANTINUCLEON–NUCLEON SCATTERING. B.J.Malenka and H.Primakoff.
Phys. Rev., Vol. 105, No. 1, 338-43 (Jan. 1, 1957).

The total isotopic spin operator and its square are determined for the quantized nucleon—antinucleon field. In the customary configuration space representation, it is found that in the formula for the total isotopic spin of a system of nucleons and antinucleons, the antinucleons contribute terms with the transposed negatives of the τ operators replacing the corresponding τ's. The form that has been usually anticipated is found only after a suitable canonical transformation. The results are specifically applied to a two-particle system consisting of a nucleon and an antinucleon. Expressions are also obtained for the isotopic spin dependence of the ratio of elastic charge exchange to elastic noncharge exchange scattering of an antiproton by a proton, and, of the ratio of elastic noncharge exchange scattering of an antiproton by a neutron and by a proton. These are discussed and evaluated under certain simplifying assumptions. A.

530.145

2999. THE CONTRIBUTION OF TENSOR FORCES TO $n-\alpha$ SCATTERING. A.Sugie, P.E.Hodgson and H.H.Robertson.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 1-16 (Jan., 1957).

The splitting of the p-phase shifts due to tensor forces is calculated for $n-\alpha$ scattering using the resonating group method and Gaussian wave-functions and potentials. It is found that the tensor force can account for about 30% of the observed splitting. A.

530.145

3000. DISPERSION RELATIONS FOR FORWARD SCATTERING OF SPIN ZERO PARTICLES BY AN EXTENDED POTENTIAL. F.Mandl.
Proc. Phys. Soc. A, Vol. 70, Pt 3, 183-7 (March, 1957).

Dispersion relations are derived for the scattering in the forward direction of spin-zero (scalar or pseudoscalar) particles by a real, extended potential. The contribution from the bound states is expressed in terms of the residues of the bound-state wave-functions in momentum space at the resonance energies. A.

530.145

3001. THE ANOMALOUS MAGNETIC MOMENT OF NUCLEONS. G.N.Vyalov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 620–4 (1956). In Russian.

The anomalous magnetic moment of nucleons has been computed taking into account the excited states with a spin of $\frac{3}{2}$ and an isotopic spin $\frac{1}{2}$. Diverging expressions are obtained which can be regularized by means of Feynman multipliers. A cut-off factor can be chosen to yield agreement between theory and experiment. A.

530.145

3002. DISPERSION RELATIONS FOR SCATTERING OF π-MESONS BY DEUTERONS. B.L.Ioffe, I.Ya.Pomeranchuk and A.P.Rudik.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 712-13 (1956). In Russian.

The relations differ from those for a free nucleon in that they depend on the polarization of the deuteron. They also include a matrix element for capture of a π-meson by a deuteron, going into two nucleons. G.E.Brown

530.145

3003. THE IMPULSE APPROXIMATION. I.M.Shmushkevich.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 725-6 (1956). In Russian.

Whereas Brueckner has shown that impulse approximation yields wrong results for the total cross-section, at high energies it gives the small-angle differential cross-section correctly. G.E.Brown

530.145 : 539.185

3004. THREE-BODY PROBLEM WITH SHORT-RANGE FORCES. I. SCATTERING OF LOW-ENERGY NEUTRONS BY DEUTERONS. G.V.Skornyakov and K.A.Ter-Martirosyan.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 775-90 (1956). In Russian.

An exact solution of the three-body problem was obtained for the limiting case of forces of vanishingly short range. The Schroedinger equation for a three-particle system is reduced (if motion with a given moment is considered) to an integral equation for a function of a single variable. The solution is applied to calculate the scattering cross-section for neutrons on deuterons. In the limiting case of zero neutron energy the theory yields the following values for the scattering amplitudes: $a_{3/2} = 0.51 \times 10^{-12}$ cm, $a_{1/2} = 0.30 \times 10^{-12}$ cm. A.

530.145 : 539.152.1

3005. THREE-BODY PROBLEM WITH SHORT-RANGE FORCES. II. G.V.Skornyakov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1046-54 (1956). In Russian.

An iteration method for determining the wave-function and binding energy of a three-body system is proposed for the case of short-range forces. The method was applied to investigate the ground state of the H^3 nucleus. A.

530.145

3006 ON CONSTRUCTION OF THE SCATTERING MATRIX. I. INTEGRAL CAUSALITY CONDITION IN BOGOLYUBOV'S METHOD. B.V.Medvedev.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 791-802 (1956). In Russian.

The integral causality condition in Bogolyubov's method for construction of the scattering matrix was formulated. Compatibility of the conditions imposed on the scattering matrix was proved on basis of this method; the existence theorem was also proved. The explicit form of the scattering matrix in local theory was obtained. A.

530.145

3007. THEORY OF THE LINEAR HARMONIC OSCILLATOR WITH THE AID OF NON HERMITIAN CANONICAL VARIABLES. J.Romain.
Bull Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 3, 362-7 (1956). In French.

A quantum-theoretical treatment. For the canonical variables p and q a solution is obtained in terms of infinite non-Hermitian matrices. The usual Hermitian solution appears as a particular case for which the matrices for p and q are reducible. It is shown that the formalism is related to the Dirac method of field quantization involving two oscillators. L.S.Goddard

530.145

3008. QUANTUM-MECHANICAL MANY-BODY PROBLEM WITH HARD-SPHERE INTERACTION. K.Huang and C.N.Yang.
Phys. Rev., Vol. 105, No. 3, 767-75 (Feb. 1, 1957).

The system under consideration is an N-particle quantum mechanical system enclosed in a volume V, in which the particles interact via two-body hard-sphere potentials, with hard-sphere diameter a. The two-body hard-sphere problem is first discussed by a generalization of Fermi's pseudopotential by means of which the problem is formulated entirely in terms of the scattering phase-shifts. It is then shown that a pseudopotential for the N-body problem can be introduced, and leads to an expansion of the energy levels of the system in powers of a. The first order energy levels of a Bose and a Fermi system are calculated. For the Bose system, the first order energy formula exhibits an "energy gap" above the ground state, leading to properties of the system not dissimilar to that of a superfluid. The ground state energy for a Bose system is calculated to order a^3 and that for the Fermi system, to order a^2. The physical interpretation and validity of these results are discussed. A.

530.145 : 530.162

3009. IMPERFECT BOSE GAS WITH HARD-SPHERE INTERACTION. K.Huang, C.N.Yang and J.M.Luttinger.
Phys. Rev., Vol. 105, No. 3, 776-84 (Feb. 1, 1957).

The method developed in the preceding abstract is a applied to a calculation of the grand partition function of an imperfect Bose gas with hard-sphere interactions. The grand partition function is calculated to second order in an expansion in powers of a/λ, where a is the hard-sphere diameter and λ the thermal wavelength. The approximate equation of state for the gas phase is thereby obtained by calculating all the virial coefficients to order $(a/\lambda)^2$. The first-order energy levels obtained in the previous paper embody some interesting physical properties. A fictitious system with exactly such energy levels is considered. The partition function for such a system can be calculated exactly and the exact equation of state obtained. It is shown that there is a phase transition, which more closely resembles an ordinary gas-liquid transition than the Bose–Einstein condensation. A.

530.145

3010. MANY-PARTICLE SYSTEMS. II. H.R.Post.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 936-8 (Dec., 1956).

For Pt I see Abstr. 8637 (1953). The general problem of many identical particles interacting through pair forces is considered. G.E.Brown

530.16

3011. CAUSALITY AND THE DISPERSION RELATION: LOGICAL FOUNDATIONS. J.S.Toll.
Phys. Rev., Vol. 104, No. 6, 1760-70 (Dec. 15, 1956).

"Strict causality" is the assumption that no signal whatsoever can be transmitted over a space-like interval in space-time, or that no signal can travel faster than the velocity of light in vacuo. In this paper a rigorous proof is given of the logical equivalence of strict causality ("no output before the input") and the validity of a dispersion relation, e.g., the relation expressing the real part of a generalized scattering amplitude as an integral involving the imaginary part. This proof applies to a general linear system with a time-independent connection between the output and a freely variable input and has the advantage over previous work that no tacit assumptions are made about the analytic behaviour or single-valuedness of the amplitude, but, on the contrary, strict causality is shown to imply that the generalized scattering amplitude is analytic in the upper half of the complex frequency plane. The dispersion relations are given first as a relation between the real and imaginary parts of the generalized scattering amplitude and then in terms of the complex phase shift. A.

530.162

3012. THE STATISTICAL DESCRIPTION OF ASSEMBLIES WITH COLLECTIVE INTERACTION. G.Ecker.
Appl. sci. Res. B, Vol. 5, No. 1-4, 321-6 (1955). In German.

A descriptive account of a detailed analysis previously published by the author (Abstr. 5899-900/1955). Discrepancies between results obtained by various analytic approaches are attributed to the inapplicability of the idealized model on which they are based. E.A.Ash

530.162

3013. A QUANTUM-STATISTICAL THEORY OF TRANSPORT PROCESSES. H.Mori.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1029-44 (Oct., 1956).

A quantum-statistical method of finding molecular expressions for kinetic coefficients is formulated so as to be applicable to the case where the external disturbance which made a system deviate from equilibrium cannot be taken as a definite additive term in the Hamiltonian of the system, such as the heat conduction and the viscous flow. This method provides an extension of the fluctuation-dissipation theorem to such quantum-mechanical systems. A quantum-statistical expression for the entropy of a non-equilibrium system is defined so as to be consistent with Gibbs' relation, and is shown to give a quantum-statistical basis for the thermodynamics of irreversible processes. Two ways of applying this method to each special system are shown; one is concerned with deriving the phenomenological equations of motion, and the other with calculating the entropy production of the system. Thus, quantum-statistical expressions are obtained for the relaxation time of an energy transfer between two sub-systems and that of momentum relaxation phenomena, and for the coefficients of thermoelectricity. A.

530.162 : 536.7

3014. PHASE SPACE CALCULATIONS. G.E.A.Fialho.
Phys. Rev., Vol. 105, No. 1, 328-37 (Jan. 1, 1957).

A new approach is used for the calculation of volumes in phase space, using the saddle point approximation to solve the integrals. Thermodynamic concepts of temperature, free energy, and entropy are used. Results are compared with the nonrelativistic, extreme relativistic, and Fermi approximations. Applications are made to several systems expected (by the Gell–Mann and Pais scheme) to result from collisions usually produced in laboratory. A rough empirical method of calculation is also given. A.

530.162

3015. RELATION BETWEEN THE CANONICAL AND GRAND CANONICAL ENSEMBLE. M.B.Lewis.
Phys. Rev., Vol. 105, No. 2, 348-53 (Jan. 15, 1957).

The "conventional" pressure $\langle \bar{p} \rangle$ in a grand canonical ensemble is shown to be, in the limit of infinite systems, identical with the canonical pressure, whenever the canonical pressure exists. The average density $\bar{\rho}$ in a grand canonical ensemble is shown to exist except at condensation. A.

530.162

3016. TEMPERATURE DEPENDENT ENERGY LEVELS IN STATISTICAL MECHANICS. E.W.Elcock and P.T.Landsberg.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 161-8 (Feb., 1957).

A general statistical-mechanical method for introducing temperature-dependent "energy levels" is developed. Previous discussions of this problem are included as particularizations of the general treatment and are unnecessarily restrictive. It is shown that appropriate definitions and procedures depend upon the nature of the information available or, alternatively, on the nature of the information it is desired to obtain. Simple and typical problems are considered in illustration of the general results. A.

530.17 : 539.1

3017. SOME APPLICATIONS OF THE METHOD OF DIMENSIONS TO ATOMIC PHYSICS. G.K.T.Conn and E.E.Crane.
Amer. J. Phys., Vol. 24, No. 8, 543-9 (Nov., 1956).

The analysis of problems by the method of dimensions is well known and has an important place in teaching, since successful application requires a clear understanding of the mechanism studied. Conversely it provides elementary and direct conclusions from particular assumptions or models. Application in the field of atomic physics seems to have been meagre. This is unfortunate since not only are many expressions commonly derived by detailed analysis seem to be dimensionally essential but comparison is readily offered between classical and quantum physics. These matters are illustrated by considering a wide range of examples. A.

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.231

3018. MOMENTS OF INERTIA OF SOLID RECTANGULAR PARALLELOPIPEDS, CUBES, AND TWIN CUBES, AND TWO OTHER REGULAR POLYHEDRA. J.Satterly.
Amer. J. Phys., Vol. 25, No. 2, 70-8 (Feb., 1957).

The derivation and verification of the values of the moments of inertia of simple solids such as rectangular blocks and cubes and combinations of two cubes and also of the regular polyhedra afford good exercise in theory and practice. The formule lead readily from one to the next. The verification of the values obtained have been made with a torsion wire and frame and a good stopwatch. A.

531.258 : 535.55

3019. A PHOTOELASTIC METHOD OF TWO-DIMENSIONAL SEPARATION OF STRESSES ALONG A LINE OF SYMMETRY BY USING THE ISOCHROMATIC FRINGES ONLY. P.D.Flynn and R.Guernsey,Jr; S.P.Christodoulides.
Brit. J. appl. Phys., Vol. 7, No. 11, 419 (Nov., 1956).

A paper by Christodoulides (Abstr. 4855/1956) in which the method was originally described, is criticized and the method of stress determination shown to be invalid. The conclusion of Christodoulides is incorrect and the present authors show why. Christodoulides, in an appended note, agrees. H.G.Jerrard

531.258

3020. ON THE BUCKLING OF AN ELLIPTIC PLATE WITH CLAMPED EDGE. I. Y.Shibaoka.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1088-91 (Oct., 1956).

The buckling of a uniform thin elliptic plate with clamped edge whose periphery is subject to a uniform normal pressure in the plane of the plate is solved formally in an exact manner by the use of hyperbolic functions, circular functions, Mathieu functions and modified Mathieu functions. An approximate formula for the relationship between the critical buckling load and the eccentricity of the elliptic plate is derived, correct to the fourth power of the eccentricity, which may be used in cases when the eccentricity is not large. A.

531.258

3021. STUDY OF DEFORMATIONS OF A PLATE OF AN ELASTIC SUSPENSION. J.E.Plainevaux.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 922-8 (Oct., 1956). In French.

A general method is derived for calculating the plane deformations of a single plate of an elastic suspension. The method can be used for determining the vertical contraction of a plate for which the tangents to the extremities of the neutral axis are not parallel and for studying the deformation when the plate is stiffened centrally, or when the suspension is no longer symmetrical or symmetrically loaded. H.J.H.Starks

531.31

3022. DYNAMICAL PRINCIPLE FOR CLASSICAL MECHANICS. P.Stehle.
Amer. J. Phys., Vol. 24, No. 9, 626-9 (Dec., 1956).

The dynamical principle underlying nonrelativistic classical particle mechanics is stated in a way which brings it into exact

analogy with the quantum principle. The classical equations of motion for a dynamical variable are then displayed in forms analogous to the Schrödinger, Heisenberg, and interaction forms in quantum theory. A.

531.314

3023. HAMILTON'S PRINCIPLE AS A COMPUTATIONAL DEVICE. P.H.Miller,Jr.
Amer. J. Phys., Vol. 25, No. 1, 30-2 (Jan., 1957).

Hamilton's principle is used as a computational device to obtain the period of a simple pendulum and a bead sliding along a parabolic wire to second-order terms in the amplitude. A motion of the form $\theta = \theta_0 \sin\omega t$ is assumed and the following question is asked: How shall one choose the amplitude θ_0 so as to make the line integral of the Lagrangian extremum for the observed period $\tau = 2\pi/\omega$? In the case of planetary motion and for the simple functions selected the period is given correctly only to first-order terms in the eccentricity. A.

531.35

3024. CENTRIPETAL FORCE DEMONSTRATION. A.J.Read.
Amer. J. Phys., Vol. 24, No. 7, 531–2 (Oct., 1956).

Describes a means of measuring radial tension during uniform circular motion, using a spring balance. The main object of the apparatus is instructional. N.Corcoran

531.38

3025. REMARKS ON "A MECHANICS DEMONSTRATION". F.S.Crawford, Jr.
Amer. J. Phys., Vol. 24, No. 6, 459 (Sept., 1956).

In the problem discussed in Abstr. 2703 (1956) the attached mass was at the end of the rod. It is shown that if the mass be attached at any point along the rod, for the position at 2/3 of the rod's length from the pivot the final angular velocity is equal to that for the free rod. S.Weintroub

531.38

3026. PITCHING MOVEMENT OF AN ELEMENTARY SUSPENSION ON ELASTIC STRIPS. J.E.Plainevaux.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1133-41 (Nov., 1956). In French.

A horizontal plate mounted on two identical vertical elastic strips, rigidly fixed to its ends and clamped vertically at their lower extremities, tilts whenever it is moved laterally, through a small angle of the second order in the horizontal displacement, unless the loading of the plate is symmetrical. If such pitching is to be reduced to a minimum, there is an optimum position for the line of action of the horizontal displacing force, which is approximately mid-way between the plate and the fixed ends of the strips. But the application of the force in the plane of the plate may be preferable, for this makes the system less sensitive to vibrations and involves only a third-order error in the orientation of the plate. J.G.Oldroyd

531.383

3027. MECHANICAL TOP WITH MAGNETIZED AXLE. R.W.Christy.
Amer. J. Phys. Vol. 24, No. 7, 523–4 (Oct., 1956).

Top consists of a brass flywheel, with a cylindrical axle terminating in a brass ball. This ball is held in a hemispherical cup which is rotated about a vertical axis; the axle carrying the flywheel is magnetized and can be turned in any direction up to 60° from the vertical. Fundamental theorems on angular motion can be verified and the apparatus also demonstrates precession of orbits in atomic physics. N.Corcoran

531.383

3028. PRECESSION OF A GYRO AND MODEL OF A GYRO-COMPASS. G.D.Scott.
Amer. J. Phys., Vol. 25, No. 2, 80-2 (Feb., 1957).

Two aids to the teaching of gyroscopic motion are given: (1) the precession of a gyro is discussed as a rotational analogy to the case of a stone whirling on the end of a string; (2) precession is explained qualitatively in terms of linear dynamics. As an example of precession a north seeking gyro-compass is considered and a model is described which illustrates its behaviour. A.

531.52

3029. INEXPENSIVE FREE-FALL APPARATUS. H.J.Rozycki.
Amer. J. Phys., Vol. 24, No. 6, 460 (Sept., 1956).

Describes a means of recording the acceleration of a falling body by a trace on a waxed length of paper, similar in principle to an Atwood's machine. A value of 960 cm/sec^2 is obtained for g. N.Corcoran

531.551

3030. MAXIMUM RANGE OF A PROJECTILE IN A VACUUM. D.B.Shaffer.
Amer. J. Phys., Vol. 24, No. 8, 585–6 (Oct 1956).

Deals with problem of projectile ranges of the order of thousands of miles, and gives a formula, obtained from pure geometry, claimed to be as accurate and simpler than the series of formulae given by Baker and Hart (Abstr. 5237/1955). No allowance is made for the air resistance or for the rotation of the earth. N.Corcoran

531.551

3031. MAXIMUM RANGE OF A PROJECTILE IN VACUUM ON A SPHERICAL EARTH. L.Blitzer and A.D.Wheelon.
Amer. J. Phys., Vol. 25, No. 1, 21-4 (Jan., 1957).

Expressions are derived for the maximum range of a projectile in vacuum on a spherical earth in terms of the ratio of kinetic to potential energy at launch. These results are combined with those for the corresponding launch angle and presented graphically. Limiting conditions are discussed, and the effect of the earth's rotation is indicated. A.

531.612

3032. MOMENTUM CONSERVATION EXPERIMENT. R.W.Christy.
Amer. J. Phys., Vol. 24, No. 8, 580–1 (Nov., 1956).

Describes a demonstration apparatus, in which a coin is placed on the edge of a table, and receives a blow in a horizontal direction; it strikes a target coin, and the distances travelled by both coins are measured. This may be used to demonstrate classical mechanics, or as an illustration of collisions between individual nuclei. N.Corcoran

531.66

3033. MODIFICATION OF THE BALLISTIC PENDULUM EXPERIMENT. D.G.Ivey.
Amer. J. Phys., Vol. 24, No. 6, 459-60 (Sept., 1956).

Conservation of momentum may be verified by firing a rifle bullet into a block of wood, if the velocity of the bullet is independently measured. The bullet passes through two thin foils a known distance apart, and the time taken determined by an electronic method: either a current flows into a condenser during this time (the resultant charge being a measure of the time taken), or the breaking of the first foil starts a horizontal sweep on an oscilloscope, and the breaking of the second foil causes a transient vertical deflection (the length of the horizontal trace being a measure of the time). N.Corcoran

MECHANICAL MEASUREMENTS 531.7

531.71 : 531.72

3034. STATISTICAL APPROACH TO SPATIAL MEASUREMENT. A.M.Russell.
Amer. J. Phys., Vol. 24, No. 8, 562–7 (Nov., 1956).

A method of determining length is described which reduces the measurement to a counting operation. The same technique is then applied to the measurement of flat areas and sections of the surface of a sphere. The limits of error are discussed and in particular the dependence of the error upon shape and the choice of a lattice is observed in the measurement of flat areas. Some possible applications are suggested. A.

531.715.2 : 535.822.9

MEASUREMENT OF THE DIAMETER OF OPAQUE CYLINDERS BY SCANNING MICROSCOPY. See Abstr. 2101.

531.717.7

3035. PRECISION MEASUREMENT OF SMALL RADII OF CURVATURE. R.N.Wilson.
J. sci. Instrum., Vol. 33, No. 12, 487-8 (Dec., 1956).

The conditions for the accurate measurement of small radii of curvature by microscope methods are discussed and the relevant formulae stated. A.

531.721

3036. HATCHET OR HACKSAW BLADE PLANIMETER. G.Barnes.
Amer. J. Phys., Vol. 25, No. 1, 25-9 (Jan., 1957).

The hatchet or hacksaw blade planimeter, consists only of a sharpened pointer, a rigid arm, and a knife edge. Its theory was first given by F.W.Hill (1894) and was later simplified by Satterly.

Hill and Satterly showed that the numerical value of the area within a closed curve traversed in the proper manner by the pointer is equal to the product of the length of the planimeter arm and the net displacement suffered by the knife-edge as measured along an arc with the pointer at the centre of curvature. The present paper gives a relatively simple derivation yielding essentially the same result but using an entirely different method of approach. It is also shown that the procedure for operating this planimeter can be simplified when determining certain types of closed curves. The accuracy of the planimeter is discussed. A.

531.758 : 535.327.3

GAS DENSITY MEASUREMENT USING SCHLIEREN SYSTEM. See Abstr. 1995

531.765 : 537.533.3

3037. THE PHYSICAL BASES OF AN ELECTRON-OPTICAL CHRONOGRAPH. E.K.Zavoĭskiĭ and S.D.Fanchenko.
Dokl. Akad. Nauk SSSR, Vol. 108, No. 2, 218–21 (1956). In Russian.

An optical system forms an image of the rapid visible process under investigation on a photocathode and the resulting electrons are focused on to a fluorescent screen giving an intensified image. When used as a chronograph the electron beam is scanned magnetically or electrically. Calculations are made of the resolving time which can lie between 10^{-9} and 10^{-14} sec. A.L.Mackay

531.768 : 621.389

3038. ON THE ACCURACY OF THE FREQUENCY OF LIGHT FLASHES USED FOR THE MEASUREMENT OF ACCELERATION DUE TO GRAVITY. P.Devaux, A.Thulin and J.Trognon.
C.R. Acad. Sci. (Paris), Vol. 242, No. 23, 2702-4 (June 4, 1956). In French.

The acceleration due to gravity is being measured at the International Bureau of Weights and Measures by photographing the lines on a free-falling graduated scale, the scale being illuminated every 0.01 sec by flashes of light lasting 0.2 μsec produced by discharging a condenser by a hydrogen thyratron through a krypton discharge tube. Variable time delays in the thyratron and in the circuits generating the 100 c/s control signal from the 100 kc/s output of a crystal-controlled oscillator were assessed by displaying the light curve of the discharge tube on a cathode-ray tube, the X-shift being controlled by the 100 c/s or 100 kc/s signal. The uncertainty of the time of discharge, as found by photographing a large number of events, did not exceed ±0.05 μsec. A.H.Cook

531.781 : 620.172

3039. DYNAMOMETER FOR TENSILE TESTING OF HIGH POLYMERS. A.R.Payne and J.F.Smith.
J. sci. Instrum., Vol. 33, No. 11, 432-5 (Nov., 1956).

The instrument described, for measuring static and dynamic stresses, is a new type of dynamometer that has been found useful, especially in tensile testing of high polymers. This dynamometer measures force by the deformation of a proof ring. Load range and sensitivity can be changed instantaneously by adjusting an attenuator in the electronic circuit; this obviates the necessity for stopping the test and changing the pendulum weight of the conventional test machine, and also gives a much greater range of loads. A fine gain control on the amplifier driving the recorder can be calibrated in terms of specimen thickness, which in conjunction with special scales for use on the recorder chart, makes the instrument record stresses directly in pounds per square inch. Frictional and inertia effects, which occur only in the recorder, are considerably reduced, and if a cathode-ray-oscillograph is used instead of the recorder, friction and inertia are virtually eliminated and rapid force changes can be followed. The dynamometer is robust in design, linear in response to force, and easily adaptable to all present-day types of rubber tensile testing machine. Preliminary tests show that the instrument gives more reproducible results in tensile tests on rubber than do pendulum machines. A.

531.787

3040. SQUIRTING MANOMETER. J.R.Green and R.Thomas.
Amer. J. Phys., Vol. 25, No. 2, 98–100 (Feb., 1957).

An analysis is made of the process of emptying a full, open manometer by increasing the pressure at the closed side until the liquid is contained only in the open side, filling the tube; a slight increase in pressure will then result in an explosive eruption of the liquid. A.

531.787 : 621.317.39

3041. AN ELECTRICAL INDICATOR FOR A MERCURY U-TUBE MANOMETER. A.E.Hawkins.
J. sci. Instrum., Vol. 33, No. 11, 412-14 (Nov., 1956).

The metal limbs of a U-tube act as outer conductors of two cylindrical capacitors. The tubes are coated internally with a thin layer of a dielectric material. The mercury acts as a variable inner conductor. The system can be made very sensitive and has a general scatter of less than ± 1 mm of mercury. A.

MECHANICS OF FLUIDS 532

532.13/.14

3042. VISCOSITY AND DENSITY OF THE LIQUID SYSTEM TNT–PICRIC ACID AND FOUR RELATED PURE MATERIALS. D.W.Moore, L.A.Burkardt and W.S.McEwan.
J. chem. Phys., Vol. 25, No. 6, 1235-41 (Dec., 1956).

The viscosity and density were investigated over a range of temperature which included both normal and supercooled liquids. The temperature-dependence of viscosity was found to be best represented by a continuous exponential function of the type $\eta = A \exp(B/T + C/T^2)$, which yielded a good fit to the data even well into the supercooled region. Density in each case was found to vary linearly with temperature across the entire range. The results are interpreted as arising from an inverse temperature dependence of the flow activation energy, ΔE_{vis}. It is suggested that ΔE_{vis} may drop to zero at sufficiently high temperature and pressure. A.

532.137

3043. MEASUREMENT OF HIGH VISCOSITIES BY SHEARING BETWEEN PARALLEL PLATES. F.E.Humphreys and N.Stone.
J. sci. Instrum., Vol. 34, No. 1, 26-7 (Jan., 1957).

Viscosities in the range 10^4-10^7 poises have been measured by shearing thin films between two parallel stainless steel plates. In this way frictional heat is rapidly dissipated, temperature being registered by a thermistor. A.

532.24

3044. THE INSTABILITY OF A LAYER OF FLUID HEATED BELOW AND SUBJECT TO THE SIMULTANEOUS ACTION OF A MAGNETIC FIELD AND ROTATION. II. S.Chandrasekhar.
Proc. Roy. Soc. A, Vol. 237, 476-84 (Nov. 20, 1956).

The theory described in Pt I (Abstr. 9961/1954) is extended to include the possibility that a layer of fluid heated below and subject to the simultaneous action of a magnetic field and rotation can become unstable via a marginal state of purely oscillatory motions. It is shown that depending on the value of the non-dimensional parameters Q and T and the coefficients of kinematic viscosity and thermal and electrical conductivities, instability can set in either as convection or as overstability. Numerical results are derived for the case when the physical constants are those applicable to mercury at ordinary temperatures. The nature of the effects one may expect to observe are illustrated. A.

532.24

3045. ON THEORY OF STABILITY OF A LAYER LOCATED IN A GRAVITATIONAL FIELD WITH A SUPERADIABATIC TEMPERATURE-GRADIENT. V.N.Gribov and L.É.Gurevich.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 854-64 (1956). In Russian.

Stability of a gas or a liquid layer in the presence of a superadiabatic temperature-gradient is investigated for the cases when the upper and lower layer boundaries are not fixed and the convection current which arises in the layer can spread into the bordering stable regions. A.

532.5 : 538.3 : 530.12

HYDRODYNAMICS IN FANTAPPIÈ'S RELATIVITY. See Abstr. 2957

532.517

3046. ON FULLY DEVELOPED TURBULENT FLOW IN CURVED CHANNELS. A.W.Marris.
Canad. J. Phys., Vol. 34, No. 11, 1134–46 (Nov., 1956).

Formulae for the radial distribution of velocity and vorticity for the case of fully developed turbulent flow in the channel between concentric and infinitely long cylinders are developed on a similarity vorticity transfer theory, by postulating an Eulerian mixing length function dependent on both position and radius of curvature. The theoretical results obtained for the mean velocity distribution across the channel compare satisfactorily with existing experimental data when the curvature dependent parameters are given appropriate numerical values.

532.517.4

3047. ON THE APPROACH TO THE FINAL PERIOD OF DECAY IN ISOTROPIC TURBULENCE ACCORDING TO HEISENBERG'S TRANSFER THEORY. W.H.Reid.
Proc. Nat. Acad. Sci. U.S.A., Vol. 42, No. 8, 559-63 (Aug., 1956).

The final period of decay is defined as that period in the decay of turbulence for which the non-linear terms in the Narvier—Stokes equation are negligible; the Reynolds number is about 5 but is not constant. In the analysis it is shown that the skewness factor, S, in the final period approaches a non-zero constant value. The value of S/k, where k is a constant of order unity, defining the transfer function, varies by less than a factor of three throughout the whole history of the turbulence. In the final period, the individual Fourier coefficients of the velocity field do not interact but decay through direct viscous action. Statistical dependence between Fourier coefficients does exist and persists, but for Heisenberg's theory its universal character is determined only by the transfer mechanism.
J.S.G.Thomas

532.582.3

3048. THE DRAG ON A CIRCULAR CYLINDER PLACED IN A STREAM OF VISCOUS LIQUID MIDWAY BETWEEN TWO PARALLEL PLANES. Y.Takaisi.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1092-5 (Oct., 1956).

The drag on a circular cylinder placed in a slow stream of viscous liquid midway between two parallel planes was first obtained in numerical form for a special case by Bairstow, Cave and Lang as early as 1921 on the basis of Stokes' equations of motion. In 1923, Harrison obtained an analytical expression for the drag experienced by the cylinder using a kind of image method. But, no agreement can be found between these two results. In this paper the same problem is treated by a method based upon Stokes' equations of motion using image methods which are developed by Faxén in the case of sphere problem. The result is in good agreement with Harrison's. A.

532.594

3049. WAVE MOTIONS ON A FREE OIL SURFACE. J.R.D.Francis.
Phil. Mag. (Eighth Ser.), Vol. 1, 685-8 (July, 1956).

It is found that when air is blown over an oil surface in a wind tunnel there is a certain critical windspeed at which tiny ripples occur on the surface which rapidly grow and accelerate downwind. Experiments on a number of viscous liquids show that viscosity has a large effect upon ripple height and speed though not upon the critical windspeed. The results are in accord with the Kelvin—Helmholz instability of surface waves. It was found possible to measure the shear stress of the wind on oil surfaces but the hygroscopic nature of syrup, which was also used, rendered it impossible to measure the stress on its surface. T.C.Toye

532.594 : 535.8

APPLICATION OF THE SCHLIEREN TECHNIQUE TO THE STUDY OF RIPPLES. See Abstr. 2098

CAPILLARITY 532.6

532.613 : 536.7

3050. CURVED FLUID INTERFACES. II. THE GENERALIZED NEUMANN FORMULA. F.P.Buff and H.Saltsburg.
J. chem. Phys., Vol. 26, No. 1, 23-31 (Jan., 1956).

For Pt I see Abstr. 7184 (1956). Following an analysis of the phenomenological concept of surface stress, the confluence properties of three fluid phases are examined from the molecular point of view. The detailed theory leads to a generalization of the Neumann surface tension triangle, which provides a boundary condition for the Laplace equations describing the surfaces of a fluid lens. It is found that the classical equation must be supplemented by a thermodynamic length parameter which, however, does not contribute to the Archimedean equilibrium of the lens. As in Pt I, the first-order correction terms of the theory again provide criteria for the breakdown of thermodynamic concepts. A.

532.613.2 : 532.583

3051. SURFACE TENSION AND FLOATING BODIES. E.K.Chapin.
Amer. J. Phys., Vol. 24, No. 8 587 (Oct., 1956).

To answer a criticism of his earlier studies on the flotation of razor blades (Abstr. 2712/1956) the author has repeated his work using thin aluminium sheets. The results are confirmed despite the perforations in the razor blades. The observations are that the percentage of the lift due to surface tension varies inversely as the length of side and that objects making little surface contact are practically entirely supported by surface tension. The depressions of the film at the point of contact, however, is sufficient to displace a weight of water equal to the weight of the body, and the results are thus quite consistent with the Archimedes principle. T.C.Toye

MOLECULAR THEORY OF LIQUIDS 532.7

532.7 : 533.7 : 537.56 : 537.571

3052. ON THE DYNAMICS OF A NON-UNIFORM ELECTRICALLY CONDUCTING FLUID. G.H.A.Cole.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 779–85 (Oct., 1956).

First steps are taken at building up a kinetic theory of ionized fluids under non-uniform conditions. The Boltzmann—Maxwell, and Fokker—Planck equations are related to molecular data, and in this way the approximations involved in their use are made clear. A.

532.7 : 534.23

3053. ULTRASONIC RELAXATION IN METHYLENE CHLORIDE. J.H.Andreae.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 71-6 (Jan., 1957).

Ultrasonic absorption measurements have been made in liquid methylene chloride between 7.5 and 210 Mc/s. These confirm recent work in the vapour by Sette, Busala and Hubbard (Abstr. 5951/1955), from which it was concluded that the relaxation of the vibrational specific heat takes place in two parts. In the frequency range studied here there is a single relaxation of specific heat equal in magnitude to the vibrational specific heat less the contribution of the lowest frequency mode of vibration. The relaxation frequency is 170 Mc/s at 25°C. A.

532.72

3054. RELATION BETWEEN THE ONSAGER AND MEASURABLE DIFFUSION COEFFICIENTS IN THREE COMPONENT SYSTEMS. M.Dole.
J. chem. Phys., Vol. 25, No. 5, 1082 (Nov., 1956).

For unidirectional diffusion a relation between the Onsager and observable diffusion coefficients is obtained under conditions which apply to a differential type diffusiometer, where the concentration gradient across the diffusing boundary is so small that the partial molal volumes of the components across the boundary can be considered independent of distance. It is planned to apply the equations to the sucrose—glucose—water system. F.Ansbacher

532.72

3055. THE ZERO-TIME CORRECTION IN FREE DIFFUSION EXPERIMENTS. H.Fujita.
J. Phys. Soc. Japan, Vol. 11, No. 5, 1018-19 (Sept., 1956).

In free diffusion experiments on dilute solutions the diffusion coefficient often varies with time according to $D(t) = D(\infty)(1 + \tau/k)$. The significance of the quantities $D(\infty)$, τ is discussed in this note.
P.T.Landsberg

532.73 : 541.135

3056. ELECTROSTATIC CONTRIBUTIONS TO THERMODYNAMIC FUNCTIONS OF SYSTEMS CONTAINING POLYMERIC IONS. F.E.Harris and S.A.Rice.
J. chem. Phys., Vol. 25, No. 5, 955-64 (Nov., 1956).

The electrostatic free energy of systems containing polymeric ions has been evaluated using a model which preserves the inhomogeneous charge distribution of the polyion. The method used includes solution of the Poisson—Boltzmann equation with largely the Debye—Huckel approximations. Allowance has been made for the finite volume occupied by the polymer chain, for the ion atmospheres about both fixed and mobile ions, and for the removal of counter ions from the solution by "site binding." A main conclusion is the verification of the previously used postulate that the screened Coulomb potential is a valid first approximation to the potential of mean force between two charges in salt solution. However, it is found that the screening constant differs from that defined in the ordinary Debye—Huckel theory. It is also shown that a polyelectrolyte model using the screened Coulomb potential implicitly includes all "osmotic" forces arising from concentration gradients due to the charges. In salt solutions it is found that the small ions

are ordinarily distributed in such a manner that the volume of a polyion is nearly electrically neutral, so that the main interactions between polyions are governed by their spatial dimensions rather than by their charge state. The small ions within the coil, referred to as "volume bound," are distinct from the "site bound" counter ions introduced previously, and are trapped within the kinetic unit of a polymer only when it is solvent entrapping. A.

MECHANICS OF GASES 533

533.15

3057. ABSORPTION OF OXYGEN AND CARBON MONOXIDE BY BARIUM ALLOY GETTERS. R.N.Bloomer.
Nature (London), Vol. 178, 1000-1 (Nov. 3, 1956).

The sorption of O_2 by a commercial getter was studied, and the speed of pumping and the amount of gas taken up (the capacity) were measured. The speed of pumping was almost independent of the ionizing electron current but varied with time and temperature. The capacity increased with increasing temperature and the results shown graphically indicate that the mechanism of gettering involves diffusion within the getter film. The getter pumps O_2 in the absence of an ionizing current, but the presence of a hot W filament influences the pumping speed. Increases in the pumping speed and capacity with temperature were also found in experiments with CO.
S.Weintroub

533.16 : 533.7

3058. CALCULATION OF THE VISCOSITY OF GASEOUS He^3 AND He^4 AT LOW TEMPERATURES. W.E.Keller.
Phys. Rev., Vol. 105, No. 1, 41-5 (Jan. 1, 1957).

The viscosity coefficients for gaseous He^3 and He^4 have been calculated to the second order approximation from $0^\circ K$ to $40^\circ K$ according to the quantum-mechanical theory of transport phenomena. Results are presented for two intermolecular potentials, the Lennard-Jones 12-6 (LJ1) and the exp-6 (MR5) functions. Contrary to expectation, LJ1 provides a better over-all fit to experimental data. A brief survey is given of the theory, previous calculations, and existing experimental data, with the conclusion that the low-temperature transport properties of the gaseous helium isotopes are not yet described with certainty by either experiment or theory. A.

533.59

3059. COPPER AS A HIGH-VACUUM MATERIAL. II. W.Espe.
Nachrichtentechnik, Vol. 6, No. 9, 401-8 (Sept., 1956). In German.

For Pt I, see Abstr. 1120 (1957). This part is devoted to glass-metal seals using oxygen-free high-conductivity copper. "Housekeeper", or feather-edged seals are described in detail, with illustrations of correct designs. The borating technique is detailed and the properties of various (German) sealing glasses are given. Disk seals and their uses are considered. A.H.W.Beck

533.59

3060. THREE DIRECTIONAL MOTION VACUUM SEALED JOINT. H.Smotrich and L.Feldman.
Rev. sci. Instrum., Vol. 27, No. 11, 970 (Nov., 1956).

A cylinder can be moved along its axis, rotated, and a cross-member pushed through it to give the third (radial) motion. The main vacuum seal is by means of an O-ring between the cylinder and its guide. K.W.Plessner

533.59 : 621.316.86

3061. GLASS RESISTOR FOR USE IN VACUUM SYSTEMS. L.G.Sloan.
Rev. sci. Instrum., Vol. 27, No. 12, 1019-21 (Dec., 1956).

Describes the construction of a conductive glass resistor intended for operation in a sealed high-vacuum system. The resistor is small, having a body size of 0.195 in. long and $\frac{1}{8}$ in. diameter, and resistance values from 0.25 to 15 megohms can be achieved. A power dissipation of 25 milliwatts is normal and in vacuum, the operating temperature is approximately $65^\circ C$. After suitable initial outgassing, no appreciable amount of gas is evolved into the vacuum system as a result of operating the resistors. A.

533.6.011 : 534.21

ACOUSTIC STREAMING NEAR AN OSCILLATING SPHERE.
See Abstr. 3077

533.6

3062. UTILIZATION OF THE GAS–HYDRAULIC ANALOGY FOR THE PURPOSES OF GAS DYNAMICS. B.G.Broude.
Zh. tekh. Fiz., Vol. 26, No. 7, 1579-94 (1956). In Russian.

A survey of a number of papers on gas–hydraulic analogy leads to the conclusion that most of the analogies used were only of qualitative nature. It is suggested, when using gas–hydraulic analogies for investigating flow over aerofoils etc., to proceed in two stages, viz. to obtain the aerodynamic characteristics of aerofoils (1) in an ideal compressible gas, and then (2) in the real gas flow. The present paper deals with the first of these stages. It has been shown that gas–hydraulic analogy can be used not only for the investigation of the qualitative behaviour of transonic gas flow, but also for obtaining quantitative results with aerofoils. It has been found that the most suitable method of using the analogy for quantitative measurements (e.g., determination of the aerodynamical coefficients of wind profiles) consists in determining pressure distribution on the surface of the bodies involved. A simple method of determining this distribution is described; it is claimed to be applicable in conditions (thicker profiles, larger angles of attack, greater Mach numbers) at which the conventional methods fail.
F.Lachman

533.6.011.5

3063. TRANSONIC FLOWS WITH SHOCK WAVE. P.Germain.
C.R. Acad. Sci. (Paris), Vol. 243, No. 17, 1190-2 (Oct. 22, 1956). In French.

The local behaviour of a transonic flow at the point of encounter with a linear sound wave and a shock wave is studied theoretically in a preliminary manner, a solution for the flow-function being derived, in the hodograph plane, as a Darboux solution of Triconi's equation; a "locally normal" shock wave is shown to be impossible, and the conditions necessary in order that an eventual solution may be derived are formulated; it is considered that a numerical study of the problem is required. J.S.G.Thomas

MOLECULAR THEORY OF GASES 533.7

533.7

3064. NON-ADDITIVE INTERMOLECULAR POTENTIAL IN GASES. I. VAN DER WAALS INTERACTIONS. Y.Midzuno and T.Kihara.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1045-9 (Oct., 1956).

The potential energy of van der Waals interactions between three spherically symmetric atoms at large separations has been investigated both by perturbation theory and by the variation method. Without using any particular atomic models the van der Waals interaction is derived, from second- and third-order perturbations, in the form
$-\mu_{12}r_{12}^{-6} - \mu_{23}r_{23}^{-6} - \mu_{31}r_{31}^{-6} + \nu(r_{12}r_{23}r_{31})^{-3}(3\cos\theta_1\cos\theta_2\cos\theta_3 + 1)$,
where r_{ij} is the distance between i th and j th atoms, θ_i's are inner angles of a triangle formed by the three atoms. An approximate relation between μ and ν is found by variation method:

$$\nu = \frac{2R_1R_2R_3(R_1 + R_2 + R_3)}{(R_1 + R_2)(R_2 + R_3)(R_3 + R_1)}$$

in which

$$\frac{1}{R_1} = \frac{1}{\mu_{12}\alpha_3} + \frac{1}{\mu_{31}\alpha_2} - \frac{1}{\mu_{23}\alpha_1} \text{ etc,}$$

α_i being the polarizability of the i th atom. In the case where three atoms are identical the relation reduces to $4\nu = 3\alpha\mu$. The accuracy of this simple relation is sufficient; for example the error is 1.8% for atomic hydrogen. A.

533.7

3065. NON-ADDITIVE INTERMOLECULAR POTENTIAL IN GASES. II. CLUSTER INTEGRALS. S.Koba, S.Kaneko and T.Kihara.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1050-4 (Oct., 1956).

The van der Waals interactions discussed in Pt I are applied to the equation of state of rare gases. The potential energy between three identical atoms is assumed to be

$$U(r_{12},r_{23},r_{31}) = U(r_{12}) + U(r_{23}) + U(r_{31}) + \nu(r_{12}r_{23}r_{31})^{-3}(3\cos\theta_1\cos\theta_2\cos\theta_3 + 1).$$

Here r_{ij} is the distance between i th and j th atoms, θ_i's are inner

angles of the triangle formed by the three atoms, and

$$U(r) = \lambda r^{-12} - \mu r^{-6}.$$

Use is made of a relation proved in Pt I, $4\nu = 3\alpha\mu$, in which α is the polarizability. For this model of the intermolecular potential, the third cluster integral including quantum effect has been calculated. By virtue of the non-additive part of the intermolecular potential agreement between observed and calculated values is very good. A.

533.7

3066. A GENERAL EXPRESSION FOR INTERMOLECULAR POTENTIALS. I.Shavitt and S.F.Boys.
Nature (London), Vol. 178, 1340 (Dec. 15, 1956).

A series expression is proposed which contains an unlimited number of adjustable constants, and in which the first term agrees closely with the Lennard-Jones 12-6 potential. E.H.Sondheimer

533.7

3067. A SIMPLIFIED MODEL OF A MULTIPLE GAS MIXTURE. G.Jarre.
R.C. Accad. Naz. Lincei, Vol. 20, No. 5, 596-604 (May, 1956), In Italian.

Considerable simplification in the fluid-dynamical and thermochemical treatment of multicomponent gas mixtures can be obtained if one makes the following assumptions: (1) The thermal diffusion coefficients of each component $D_i^T = 0$. (2) All coefficients of mutual diffusion are equal: $D_{ij} = D$. (3) and (4) $\rho D = \lambda/c_p = \mu$, with ρ = density, λ = thermal conductivity, c_p = specific heat at constant pressure, μ = viscosity. (5) It is assumed that the total pressure is constant and that there are no volume forces acting. These assumptions make possible a unified treatment of the transport of matter and heat, of the conservation of energy and of the increase in entropy. H.London

533.7 : 537.56 : 537.571 : 532.7

ON THE DYNAMICS OF A NON-UNIFORM ELECTRICALLY CONDUCTING FLUID. See Abstr. 3052

533.72 : 541.182.3

3068. CONCENTRATION CHANGES IN AN AEROSOL. E.R.Wooding.
Proc. Phys. Soc. B., Vol. 70, Pt 1, 65-70 (Jan., 1957).

The rate of coagulation of an aerosol was calculated by Smoluchowski (1917) on the assumption that every collision resulted in the coalescence of two particles. The coagulation rate when there is a potential barrier round the aerosol particles is now calculated and two examples are considered. A.

VIBRATIONS. ACOUSTICS 534

534.121.2

3069. COMPARISON OF METHODS FOR CALCULATING THE PRESSURE VARIATIONS ON A MEMBRANE. H.Jung.
Hochfrequenztech. u. ElektAkust., Vol. 65, No. 2, 37-41 (Sept., 1956). In German.

Although there are discrepancies in the results obtained by using formulae derived by different methods, it is shown that these need not arise if due attention is paid to the limitations of each method. H.J.H.Starks

534.121.2

3070. EXPERIMENTS WITH VIBRATING SOAP MEMBRANES. L.Bergmann.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1043-7 (Nov., 1956).

The natural oscillations of membranes can be studied by reflection of light from an acoustically excited soap film. In order to obtain a uniform soap film, it proves advantageous to rotate the film so that its thickness is uniform. The oscillations may be obtained even when the films have become extremely thin after long rotation. In addition, one finds strange streaming phenomena with certain natural oscillations. A.

534.131 : 534.232

3071. CONTOUR VIBRATIONS OF ISOTROPIC CIRCULAR PLATES. M.Onoe.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1158-62 (Nov., 1956).

A mathematical analysis has been done according to Love's theory. The results are: (a) The coefficients of the dilatation and the rotation are equal in amount regardless of Poisson's ratio only for the modes whose circumferential order is one. (b) The first mode whose order is two has the lowest natural frequency. This mode is practically equivoluminal, while the second mode is dilatational. (c) Locations of nodes are considered. Circular nodal lines can exist only for the radial and the tangential modes. (d) Frequencies and displacements of the most important modes are calculated. Applying the above results to barium titanate vibrators, one finds that only the radial modes can be excited with full electrodes and the compound modes with split or partial electrodes, while the tangential modes can never be excited. Such an excitation of compound modes provides a convenient means for measuring Poisson's ratio of the material. Equivalent series inductances of the radial modes are calculated. Vibrations of thick circular plates are also considered. It is shown that vibrations of certain compound modes which are practically equivoluminal can be approximated by the rotation only. Comparisons between these solutions and the above results are made to reveal that the accuracy of approximation is satisfactory. A.

534.2 : 534.222.2

3072. INTERACTION BETWEEN SHOCK WAVES AND TRAVELLING WAVES. V.Ya.Arsenin and N.N.Yanenko.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 4, 713-16 (1956). In Russian.

A mathematical analysis of the effect of the shock waves on the compressional and expansional travelling waves expressed in Riemannian form $p = A\exp(\pm v/c)$; $u = (v \pm c)t + f(v)$, where p = gas pressure, v = velocity, u = Eulerian coordinate, $c = \sqrt{p/\rho}$ (ρ = density), A = a constant, and f(v) = a function of v, for different values of the Riemannian invariants $r = c.\ln\rho + v$ and $s = -c.\ln\rho + v$. F.Lachman

534.2

3073. RAYLEIGH WAVE PROPAGATION ON ANISOTROPIC (CUBIC) MEDIA. L.Gold.
Phys. Rev., Vol. 104, No. 6, 1532-6 (Dec. 15, 1956).

The essential features of surface-wave propagation for elastic waves on anisotropic media are delineated by consideration of the solution for cubic crystals. In using the coordinate system defined by the surface and the direction normal to it, transformation of the elastic coefficient tensor is required. Conventional means for doing this can be prohibitively laborious; but by invoking the isotropy condition, the calculation becomes quite amenable. Detailed elaboration is given for propagation in the (100) and (110) planes. The set of relations from which the damping coefficient and the Rayleigh wave velocity can be evaluated is derived. A.

534.2

3074. ON THE PROPAGATION OF HIGH FREQUENCY COMPRESSIONAL WAVES IN ISOTROPIC CYLINDERS. M.Redwood and J.Lamb.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 136-43 (Jan., 1957).

The possible modes of propagation of compressional waves in solid cylindrical rods are described by the solutions of the "frequency equation". It has been found possible to solve this equation at frequencies near 10 Mc/s by a graphical method which is readily applicable. Using this method the variation of phase velocity v_p with frequency has been evaluated for the most important modes of propagation, namely those having phase velocities near to that in an unbounded medium, v_1. It is shown that in the vicinity of $v_p = v_1$ the variation of phase velocity with frequency is characterized by a series of "plateau" regions over which v_p is approximately constant, these regions being separated by "steps" through which v_p changes rapidly with frequency. Consideration of the displacement amplitudes shows that the mode with v_p nearest to v_1 has, in general, a pressure variation across the radius which is most likely to be excited experimentally under conditions described in a previous paper by the authors. A.

534.2 : 530.145 : 538.566

HIGH-FREQUENCY SCATTERING. See Abstr. 2446

534.2 : 538.3

MAGNETOELASTIC PLANE WAVES IN A CONDUCTING SOLID. See Abstr. 2439

534.2 : 539.374

STRESS-PULSE PROPAGATION IN CERTAIN POLYMERS. See Abstr. 2749.

534.21

3075. THE PROPAGATION OF SOUND IN NON-UNIFORM MEDIA. A SURVEY. L.M.Brekhovskikh.
Akust. Zh., Vol. 2, No. 3, 235-43 (1956). In Russian.

A survey paper, read at the 2nd International Acoustics Congress at Cambridge (Mass.) in June 1956. C.R.S.Manders

534.21

3076. ACOUSTIC EQUATIONS OF THE SECOND APPROXIMATION AND THE PROPAGATION OF PLANE WAVES OF FINITE AMPLITUDE. Z.A.Gol'dberg.
Akust. Zh., Vol. 2, No. 3, 325-8 (1956). In Russian.

A solution has been given by Eckart (Abstr. 1180/1948) for the second-approximation acoustic equations. In an entirely theoretical paper the present author gives a more accurate solution. The case of the adiabatic propagation of the plane waves of finite amplitude is also examined. C.R.S.Manders

534.21 : 533.6.011

3077. VISCOUS DISSIPATION CAUSED BY A SPHERE. C.A.Lane.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1194-6 (Nov., 1956).

Recent studies have led to a satisfactory solution to the problem of acoustic streaming in the vicinity of a sphere for $s/a \ll 1$, where s is the oscillation amplitude, and a is the radius of the sphere. The results of these studies have now been applied to the calculation of the inherent energy losses. The energies in the d.c. vortices and in the primary a.c. vortices have been computed, and it is shown that the energy in the former is negligible in comparison with the energy in the latter. The results are restricted to cases where $s/a \ll 1$, and $a(\omega/2\nu)^{1/2} \gg 1$, where ν is the kinematic viscosity and ω is the frequency of oscillation. A.

534.213

3078. THE PROPAGATION OF ELASTIC WAVES IN A MEDIUM WITH CYLINDRICAL CHANNELS. V.V.Tyutekin.
Akust. Zh., Vol. 2, No. 3, 291-301 (1956). In Russian.

Propagation of sound in materials such as rubber is considered. Propagation is considered to occur along a direction parallel to the long axes of the channels assumed to have diameters small compared with both their length and also with the wavelength of the disturbance. Based on the theoretical relations so derived a nomogram is constructed for the determination of the complex wave-number of a microheterogeneous medium from its known mechanical parameters and physical dimensions. Theoretical paper. C.R.S.Manders

534.213.4

3079. WAVE PROPAGATION THROUGH FLUID CONTAINED IN A CYLINDRICAL, ELASTIC SHELL. T.C.Lin and G.W.Morgan.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1165-76 (Nov., 1956).

A study is presented of the propagation of axisymmetric waves through compressible, inviscid fluid contained in a cylindrical, elastic shell. The dependence of the phase velocity as a function of frequency on four dimensionless parameters of the system is discussed and illustrated graphically. A.

534.22 : 536.412

3080. RAO'S RULE AND ITS BASIS. A SURVEY. B.B.Kudryavtsev.
Akust. Zh., Vol. 2, No. 4, 331-40 (1956). In Russian.

A survey article dealing with the empirically established relationship between the temperature coefficient of velocity in liquids and their coefficients of thermal expansion. 38 refs (11 Soviet). C.R.S.Manders

534.22 : 536.44

3081. INVESTIGATION OF THE ULTRASONIC PROPERTIES OF ETHYLACETATE IN THE CRITICAL REGION. V.F.Nozdrev and V.D.Sobolev.
Akust. Zh., Vol. 2, No. 4, 379-81 (1956). In Russian.

Reports the measurements, by a pulse method, of the velocity and absorption of ultrasound in ethylacetate along the liquid, saturated vapour and superheated vapour lines. It was found for the liquid phase that the velocity decreases with rise of the temperature and is minimum at the critical temperature. A law of rectilinear diameters is found for the acoustic rigidity of the liquid and vapour phases of ethylacetate, which was established theoretically by Nozdrev (Dokl. Akad. Nauk SSSR, Vol. 92, No. 6, 1145-6, 1953). C.R.S.Manders

534.22 : 532.12

3082. VELOCITY OF SOUND IN, AND COMPRESSIBILITY OF, AQUEOUS SOLUTIONS OF INORGANIC ACIDS. I.G.Mikhaĭlov and V.A.Shutilov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 1, 116-18 (1956). In Russian.

The velocity of sound in the aqueous solutions of hydrochloric, nitric and sulphuric acids has a concentration maximum which becomes more pronounced at lower temperatures, and a temperature maximum which disappears at concentrations of 25-30%, being replaced by a linear dependence. There is a concentration minimum for the compressibility of all the acids at all temperatures, the position of the minimum being lower the lower the temperature. The light which these measurements throw on the effect of the various ions present on the structure of water is discussed. R.C.Murray

534.222.1

3083. THE DISPERSION EQUATION FOR NORMAL WAVES IN STRATIFIED MEDIA. L.M.Brekhovskikh.
Akust. Zh., Vol. 2, No. 4, 341-51 (1956). In Russian.

A simple means is indicated for obtaining the dispersion equation for waves in such media and a number of particular cases examined. Theoretical paper. C.R.S.Manders

534.222.2

3084. THE MOTION OF A GAS UNDER THE ACTION OF A SHORT-DURATION PULSE. A.I.Zhukov and Ya.M.Kazhdan.
Akust. Zh., Vol. 2, No. 4, 352-7 (1956). In Russian.

Interpretation of the equations concerned with the passage of a shock wave through a cold gas. Results are given for the motion of a gas under the action of a finite pulse of short-duration. C.R.S.Manders

534.222.2

3085. INTERACTION OF NONUNIFORM SHOCK WAVES. W.E.Drummond.
J. appl. Phys., Vol. 28, No. 1, 76-85 (Jan., 1957).

The basic interactions of nonuniform shock waves in one-dimensional steady flow, are analysed by mapping into the hodograph plane, neglecting effects of third and higher orders in the shock strength. The resulting equations are linear and can be solved by straightforward numerical calculation. A.

534.23 : 534.26

3086. THE THEORY OF THE ULTRASONIC INTERFEROMETER. V.A.Solov'ev.
Akust. Zh., Vol. 2, No. 3, 285-90 (1956). In Russian.

The ultrasonic interferometer is widely used for the measurement of velocity of sound in liquids and gases. Its use can be extended to the measurement of the absorption coefficients, providing absorption is not great. The author puts forward a new computational formula to be applied to the interferometer measurements in order to obtain the absorption coefficients. C.R.S.Manders

534.23 : 534.24

3087. THE REFLECTION AND TRANSMISSION OF A PLANE SOUND WAVE INCIDENT AT ANY ANGLE ON A LAYERED VISCO-ELASTIC MEDIUM. S.Kästner.
Ann. Phys. (Leipzig), Vol. 18, No. 3-4, 190-219 (1956). In German.

The propagation of a sound wave through an infinite viscoelastic medium is discussed theoretically. The treatment is then extended, using a matrix notation, to a system of n parallel plane layers of viscoelastic material; from the chain matrix of the system expressions are derived for the reflected and transmitted waves as a function of the incident wave. H.J.H.Starks

534.23

3088. ULTRASONIC RELAXATION IN FREON VAPORS. Y.Miyahara and E.G.Richardson.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1016-19 (Nov., 1956).

From the point of view of their use in supersonic wind tunnels in which it is desired to obtain a high Mach number without great expenditure of power, the substitution of the air by vapours having a low velocity of sound is of interest. The freons (halogen-substituted methanes) suggest themselves for this. It is shown that these vapours have ultrasonic relaxation times in the neighbourhood of 10^{-7} sec coupled with high absorption coefficients in the ultrasonic range, a fact which may limit their usefulness in wind tunnels. The relation between relaxation times measured by other methods and by the present one are discussed. A.

534.23

3089. ACOUSTIC FILTERING IN A MOVING MEDIUM. R.F.Lambert.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1057-8 (Nov., 1956).

Formulations of one-dimensional sound propagation in a homogeneous, progressively moving medium are applied to calculations of recurrent filter characteristics of a side branch tube attached to the side wall of an air duct. The complex propagation constants and characteristic impedance are functions of the flow Mach number. Therefore, the insertion loss is dependent upon flow but relative changes with flow depend upon the terminating impedance levels as well as geometry. Neglecting dissipation the linear system is found nonreciprocal with respect to phase shift. A.

534.23

3090. DOUBLE RELAXATION EFFECTS. R.T.Beyer.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 243-8 (Feb., 1957).

Detailed consideration is given to several situations in which two relaxation processes contribute to the absorption of ultrasound. A general but rather involved expression is given for $\alpha\lambda$. From the particular cases examined, it appears that when the relaxation frequencies of the two processes are close together, a single experimental relaxational frequency will be observed, with $(\alpha\lambda)_{max}$ somewhat higher than the value obtained by combining the two separate peaks. The observed relaxation frequency will be approximately equal to the lower of the two individual relaxation frequencies. A.

534.23

3091. ATTENUATION OF ULTRASONIC WAVES OF FINITE AMPLITUDE IN LIQUIDS. V.Narasimhan and R.T.Beyer.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1233-6 (Nov., 1956).

Measurements are reported for the effect of finite amplitude on the attenuation of the fundamental component of an ultrasonic wave in water and in aqueous solutions of acetic acid and manganous sulphate. A two-crystal continuous-wave method was employed. The results in water indicate that the rate of increase of α/ν^2 with pressure becomes less with increasing frequency. This result is in contrast to earlier results of Twole and Lindsay. The rate of increase of α/ν^2 with pressure was lowered in the aqueous solutions as the concentration was increased. A.

534.23 : 539.32

3092. ACOUSTIC RELAXATION EFFECT IN Mn_3O_4. M.E.Fine and C.Chiou.
Phys. Rev., Vol. 105, No. 1, 121-2 (Jan. 1, 1957).

Internal friction effects occur in Mn_3O_4 which have been attributed to stress-induced change in the distribution of Mn^{++} and Mn^{++++}. The activation energy is 0.4 eV per unit of process responsible for the internal friction. A.

534.232

3093. CALCULATION OF THE RADIATION RESISTANCE OF CERTAIN DISTRIBUTED SYSTEMS OF RADIATORS. M.I.Karnovskiĭ.
Akust. Zh., Vol. 2, No. 3, 267-78 (1956). In Russian.

Theoretical paper. Various arrangements of coherent radiators (spheres) are set up and the active component of the radiation resistance determined. C.R.S.Manders

534.232

3094. THE INFLUENCE OF THE VELOCITY OF A SUBSONIC STREAM ON THE RADIATION IMPEDANCE OF A PISTON WITH INFINITE FLANGE. D.N.Chetaev.
Akust. Zh., Vol. 2, No. 3, 302-9 (1956). In Russian.

Earlier work (Abstr. 4289/1954) is developed further, shortcomings eradicated and some computational formulae derived. Tables are given for the real and imaginary components of the acoustic impedance for the case of a square piston. Theoretical paper. C.R.S.Manders

534.232

3095. A CYLINDRICAL RADIATOR MADE OF BARIUM TITANATE CERAMIC, RADIATING ALONG THE AXIS OF THE CYLINDER. A.A.Anan'eva.
Akust. Zh., Vol. 2, No. 3, 323-5 (1956). In Russian.

The transducer consists of a $BaTiO_3$ tube fitted with ring electrodes. When it is excited standing waves are set up in it with the frequency of the fundamental radial resonance of 40 kc/s, when diameter = λ, length = 10λ. Polar diagrams are given for 8 spot frequencies between 38 and 90 kc/s. A curve is given of the frequency against the angle at which the maximum intensity occurs, the angle being measured with respect to the plane perpendicular to the long axis of the cylinder and taken through its mid-point. C.R.S.Manders

534.232

3096. A THEORETICAL INVESTIGATION OF SOUND TRANSMISSION THROUGH HORNS OF SMALL FLARE, WITH SPECIAL EMPHASIS ON THE EXPONENTIAL HORN. J.Holtsmark, J.Lothe, S.Tjøtta and W.Romberg.
Arch. Math. Naturvid., Vol. 53, Paper 8, 43 pp.(1956).

Because of the complexity of the mathematics involved in a rigorous analysis, most horn problems are solved by means of Webster's approximate wave equation (Proc. Nat. Acad. Sci. U.S.A., Vol. 275, 1919). At low frequencies Webster's wave equation gives fairly accurate results for horns which do not flare too quickly. The main object of the present theoretical paper is to develop equations which may be used at high frequencies, the greater part of the paper being concerned with a discussion of the exponential horn. A theory for horns with arbitrary contour is also developed. A.B.Wood

534.232

3097. VIBRATIONS IN LONG RODS OF BARIUM TITANATE WITH ELECTRIC FIELD PARALLEL TO THE LENGTH. C.V.Stephenson.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1192-4 (Nov., 1956).

The theory has been developed for vibrations in long thin rods of piezoelectric barium titanate with the electric field parallel to the length. The theory shows how the coupling coefficient k_{33} and the piezoelectric constant d_{33} are related to a measurement of the fundamental resonant and antiresonant frequencies. The antiresonant frequency in this mode of vibration is controlled by the physical properties of the material in exactly the same way that these properties control the resonant frequencies in other modes. An experiment was devised, and the results of the experiment verified this result. A.

534.232 : 621.395.616

3098. CONDENSER MICROPHONES FOR MEASUREMENT OF HIGH SOUND PRESSURES. J.K.Hilliard and W.T.Fiala.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 254-60 (Feb., 1957).

A series of small condenser microphones and accessory equipment has been developed for the measurement of high sound-pressure levels. The paper derives expressions leading to the evaluation of the nonlinear distortion of the microphone, describes the construction of the several elements of the microphone system, and presents performance data. Four interchangeable microphones, all employing clamped glass plate diaphragms, provide linear measurements over a pressure range of 1 to 10^8 dynes/cm^2. The microphones are 0.6 in. in diameter and their low directivity is shown by polar response patterns. A cathode-follower tube is housed in a printed circuit base on top of which the microphone is mounted. Maximum output is 30 V r.m.s. The equipment can be used over a wide range of temperature and barometric pressure and is sufficiently rugged to withstand severe overload and rough handling. A.

534.25

3099. ULTRASONIC DOUBLE REFRACTION IN SINGLE CRYSTALS. P.C.Waterman and L.J.Teutonico.
J. appl. Phys., Vol. 28, No. 2, 266-70 (Feb., 1957).

The phenomenon of ultrasonic double refraction and methods of observing it with pulsed echo methods are described in some detail. Two causes of ultrasonic double refraction are described. Double refraction effects were observed in three germanium single crystals. The main cause of the effects reported here seems to be a small angular difference between the propagation direction and a principal axis of the crystal. A.

534.26

3100. THEORY OF THE SCATTERING OF SOUND BY A THIN ROD.. L.M.Lyamshev.
Akust. Zh., Vol. 2, No. 4, 358-65 (1956). In Russian.

A thin, infinite, elastic rod of circular cross-section is considered and an expression derived for the scattered acoustic pressure field taking into account the rod's longitudinal and flexural vibrations. A space resonance may be observed when the phase velocity of decaying incident sound waves along the rod coincides with the velocity of the flexural or the longitudinal waves in a rod immersed in a liquid. With space resonance the scattering is considerably enhanced. The Rayleigh formula for the scattering of a plane sound wave by a rod with finite compressibility and density, for incidence of the wave perpendicular to the axis of the rod, is found as a particular case of a more general solution. The effect of internal losses in the material of the rod is also discussed. C.R.S.Manders

534.26 : 534.24

3101. ON SCATTERING AND REFLECTION OF SOUND BY ROUGH SURFACES. V.Twersky.
J. Acoust. Soc. Amer., Vol. 29, No. 2, 209-25 (Feb., 1957).

Random distributions of arbitrary identical protuberances on free or rigid base planes are considered, and the approximate

reflection coefficients

$$R = \left|\frac{1 + Z}{1 - Z}\right|^2,$$

and differential scattering cross-sections per unit area

$$\sigma(\vec{s},\vec{k_i}) = \frac{\rho}{k^2}\left|\frac{f(\vec{s},\vec{k_i})}{1 - Z}\right|^2.$$

are derived.
Here

$$Z = \frac{\pi\rho f(\vec{k_o},\vec{k_i})}{k^2\vec{n}\cdot\vec{k_o}},$$

where $f(\vec{s},\vec{k_i})$ is the scattering amplitude of an isolated protuberance, $\vec{k_i}$, $\vec{k_o}$, and $\vec{s}$ are the directions of incidence, specular reflection (with respect to the base plane), and observation; $\vec{n}$ is the normal of the base; ρ is the average number of scatterers in unit area, and $k = 2\pi/\lambda$. (For a two dimensional "striated" surface Z is divided by π/k, and σ by $\pi/2k$). If the horizon angle β approaches zero (i.e., near grazing incidence), then the reflection coefficients approach unity minus terms of the order β, while the back scattering vanishes like β^4, β^2 for a free, rigid base. Explicit forms are given for arbitrary hemispheres and circular semicylinders, and for the limiting cases of free and rigid surfaces with scatterer radius very small and very large compared to wavelength. The analysis is based on a Green's function formulation of the problem of a single configuration; R and σ follow from an approximation of the ensemble averaged energy flux which takes account of multiple coherent scattering. (The transmission problem of a "random screen" is treated simultaneously). An elementary derivation is also given, and extensions to distributions of nonidentical scatterers are made. A.

534.321.9 : 621.9.02

3102. EFFECT OF VIBRATION AMPLITUDE, FREQUENCY, AND COMPOSITION OF THE ABRASIVE SLURRY ON THE RATE OF ULTRASONIC MACHINING IN KETOS TOOL STEEL. D.Goetze.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1033-7 (Nov., 1956).

Results of experiments conducted to determine the dependence of the ultrasonic machining rate V in Ketos tool steel on the peak-to-peak amplitude 2ξ on the frequency of vibration f on the abrasive particle diameter d and on the ratio of the mass of abrasive to the mass of water used in compounding the slurry are given. It is shown that within the range under investigation the quotient $V/2\xi fd$ is a constant for a critical ratio of the mass of abrasive to that of water. It is also shown that events occurring within the volume of a cube having sides equal to d are of fundamental importance in the ultrasonic machining process. A phenomenological equation is derived from which the most probable machining rate can be calculated for the range under investigation. A.

534.41

3103. VARIOUS METHODS OF PRESENTING ACOUSTIC SPECTRA. L.Cremer and L.Schreiber.
Frequenz, Vol. 10, No. 7, 201–13 (July, 1956). In German.

Various methods of measuring and representing spectra are discussed and compared. For example, the result obtained will depend on whether octave or third-interval filters are used and whether the ordinates represent amplitude or loudness. V.G.Welsby

534.611.081.1

3104. CONCERNING A REFERENCE QUANTITY FOR [SOUND] POWER LEVELS. C.M.Harris.
J. Acoust. Soc. Amer., Vol. 28, No. 5, 993 (Sept., 1956).

This note arises from a discussion as to whether 10^{-12} watt (1 picowatt) or 10^{-13} watt should be adopted as the sound power reference level. As a result of "an opinion poll of about 200 active acousticians" the following conclusions were reached: (1) There is a strong preference, both in U.S.A. and abroad, in favour of 1 picowatt as the reference for sound power, (2) The 1 picowatt level easily lends itself to standard notation, (3) The selection, 1 picowatt or 10^{-13} watt, as reference level is independent of the system of units — English or metric, and (4) The only reference values for power level, now a standard, are 1 picowatt and 1 milliwatt. It is considered that the use of two closely spaced values, such as 1 picowatt and 10^{-13} watt will serve no useful purpose and will probably lead to confusion in the future. The author considers that 1 picowatt is the better choice. A.B.Wood

534.7

3105. LEARNING, A MAJOR FACTOR INFLUENCING PREFERENCES FOR HIGH-FIDELITY REPRODUCING SYSTEMS. R.E.Kirk.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1113-16 (Nov., 1956).

Frequency range preferences of 210 college students for reproduced music and speech were determined by an A-B-A preference test. Two groups of subjects then listened to music reproduced over a restricted frequency range and a relatively unrestricted frequency range, respectively, for six and one-half weeks. The results of a post-frequency range preference test indicate that: (1) learning plays an important role in determining preferences for sound reproducing systems; (2) continued contact with a particular system produces shifts in preference for this system; (3) the average college student prefers music and speech reproduced over a restricted frequency range rather than an unrestricted frequency range; and (4) the frequency range preferences of college students are in part a function of the type of music to which they are listening. A.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

534.78 : 681.61

3106. PHONETIC TYPEWRITER. H.F.Olson and H.Belar.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1072-81 (Nov., 1956).

The important factors involved in the development of a phonetic typewriter are as follows. The particular form in which the words are typed. The means for analysing the sounds of speech. The identification of the analysed sounds. The encoding, coding, and decoding of the sounds for the operation of the actuating mechanism. The design of the mechanism for actuating the typewriter. A study has been made of these problems. As a result of this study a simplified model of a phonetic typewriter has been developed incorporating all of these aspects. This model serves to illustrate the principles involved and provides means for further study towards a complete system. A.

534.781

3107. ON THE "CHARACTERIZATION" OF SPEECH AND DICTION. A.Moles.
Ann. Télécomm., Vol. 12, No. 1, 21-32 (Jan., 1957). In French.

A preliminary study of the objective personal features of a given voice, as a basis for the typification of speakers into classes, an important problem for the psychology of perception and for interpersonal relations in which — especially when they pass through spatio-temporal channels (broadcasting, telephone, and so on) — the traits of voice are essential. A more elaborate point of view on voice characterization is the problem of identification which tries to achieve a biunivocal correspondence between the voice and the speaker. After a theoretical settlement of the problems of identification and typification, the author brings, on grounds of experience, some factors of typification and discusses their accuracy on a statistical basis, leading to the use of speech visualization. A.

534.784

3108. SPEECH ANALYSIS-SYNTHESIS SCHEME USING CONTINUOUS PARAMETERS. C.R.Howard.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1091-8 (Nov., 1956).

A device for processing speech for transmission over a narrow-band communication channel is described. This device analyses the speech waveform and extracts certain parameters continuously as a function of time. These parameters have been used to control a speech synthesizer utilizing local excitation functions to simulate vocal and turbulent sources. Equipment to carry out the analysis-synthesis procedure as it exists in its present state is discussed as well as consideration for its inclusion in a complete band-width-compression system. A.

534.784

3109. DEVELOPMENT AND TESTING OF A FORMANT-CODING SPEECH COMPRESSION SYSTEM. J.L.Flanagan and A.S.House.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1099-106 (Nov., 1956).

The development of a speech-bandwidth compression system employing formant-coding principles is described. The compression system codes the input speech in terms of seven electrical signals, representing the frequencies of the first three formants, the amplitudes of voicing and of friction, the fundamental vocal frequency, and the frequency of the spectral maximum of the fricative excitation. These signals occupy a total bandwidth of the order of 60 c/s and require signal-to-noise ratios of approximately 30 dB for their transmission. An evaluation of the intelligibility of speech transmitted by the compression system is described. Natural monosyllabic utterances are transmitted through the system and presented to listeners for identification. Vowel and consonant articulation sources are computed and sound confusion matrices are constructed and discussed. The results indicate that correct identification occurred for approximately 80% of the vowels and 25% of the consonants. A.

534.784

3110. LINGUISTIC PREREQUISITES FOR A SPEECH WRITER. Y.R.Chao.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1107-9 (Nov., 1956).

The first step in the construction of a speech writer must be concerned with the conversion of the flow of speech into discrete operations. Such operations have been brought within the realm of possibility by recent developments in the analysis and synthesis of speech in terms of frequency functions instead of pressure functions. The present paper deals primarily with the phonetic and graphic aspects of the response and discrimination required of the machine and the dictating person. Certain simplifications of design can be effected by consideration of the orthography of the language to be speech-written. A.

534.8

3111. PHYSICAL ACOUSTICS AND THE PROPERTIES OF SOLIDS. W.P.Mason.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1197-206 (Nov., 1956).

Four examples of application of acoustic techniques are discussed in the present paper. These include diffusions of nitrogen and carbon atoms in iron, the motion of domain walls in ferromagnetic nickel, the interaction of lattice vibrations with free electrons at low temperatures and the use of high-strain values in studying internal friction and fatigue in metals. These examples were chosen because they result in definitely explained effects which are indicative of typical processes occurring in solids. A.

534.833

3112. REACTIVE COMPONENTS IN SOUND ABSORBER CONSTRUCTION. C.Becker.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1068-71 (Nov., 1956).

Basic criteria are given for the incorporation of many reactive components in sound absorbers. Forms of absorbers, determined by these criteria, are derived. Design parameters are treated in relation to techniques for determining their optimum values. Many reactive components are shown to have the effect of enhancing uniformly high absorption over extended frequency ranges. A.

534.837 : 621.9

3113. THE STUDY OF MACHINE NOISE. E.Lübcke.
VDI Z., Vol. 98, No. 14, 791-7 (May 11, 1956). In German.

Discusses in general terms the effect of prolonged noise on the human body and the various methods of comparing the effective loudness of different sounds. Mention is also made of the use of screens and sound-absorbent walls to reduce machine noise to tolerable levels. (26 references). V.G.Welsby

534.843

3114. NEW COEFFICIENTS FOR THE QUALITATIVE ASSESSMENT OF THE ACOUSTICS OF ROOMS. E.E.Golikov.
Akust. Zh., Vol. 2, No. 3, 255-66 (1956). In Russian.

The author derives a new coefficient for the room acoustics and quotes experimental data in support of the contention that there is a precise single-valued correspondence between the new coefficient and the articulation at a given point in the room. C.R.S.Manders

534.843 : 612.85

3115. SUGGESTION FOR THE DEFINITION AND MEASUREMENT OF "CLEARNESS" ON A SUBJECTIVE BASIS. H.Niese.
Hochfrequenztech. u. ElektAkust., Vol. 65, No. 1, 4-15 (July, 1956). In German.

The "clearness" or "definition" (Deutlichkeit) defined by R.Thiele (see Abstr. 2215/1954) in his investigations of the acoustic characteristics of auditoria, and measured objectively, is given as the ratio of "useful" to "disturbing" sound energy. "Useful" sound energy is defined as the integral of that part of the reverberation arriving within the first 50 msec and the "disturbing" sound is the integral of all that follows after the first 50 msec. The sound source is a short pulse whilst the position of the observer can be varied. The present paper describes a study of this phenomenon on a subjective basis. Curves are shown relating the loudness of a short sound-pulse as a function of duration of the pulse — the sound heard reaching maximum loudness and remaining constant for pulse lengths exceeding 100 msec. A further discussion relates to the integrating property of the ear and to the effect of the disturbing sound limits for rooms of different reverberation times. A.B.Wood

534.843

3116. THE DEVELOPMENT OF AN APPARATUS FOR MEASURING "CLEARNESS". W.Erler.
Hochfrequenztech. u. ElektAkust., Vol. 65, No. 2, 53-9 (Sept., 1956). In German.

See preceding abstract. The paper describes electronic apparatus by means of which the "clearness" can be measured either in model or full scale-rooms. A.B.Wood

534.844 : 621.317.79

3117. AN EQUIPMENT FOR MEASURING REVERBERATION TIME. Z.Faiman.
Slaboproudý Obzor, Vol. 17, No. 6, 322-4 (1956). In Czech.

A general description of equipment suitable for measuring the reverberation time, and sound transmission and absorption coefficients of various acoustic materials. The transmitter part of the equipment consists of a white-noise source (20 c/s to 20 kc/s), a set of 9 octave band-pass filters covering frequencies of 20 c/s to 20 kc/s, a power amplifier and a loudspeaker. The receiving part consists of a microphone, a set of band-pass filters, an amplifier and a recorder (hypsograph). It is claimed that the white-noise method of measuring the acoustic parameters gives reproducible results and is more accurate than the standard single-tone measurement. R.S.Sidorowicz

OPTICS. RADIATION. SPECTRA 535

535.14

3118. SPECTRUM OF DAMPING RADIATION IN A [REFRACTING] MEDIUM. M.L.Ter-Mikaelyan.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1033-6 (1954). In Russian.

A general quantum theory of bremsstrahlung, Cherenkov radiation and refractive index is proposed and used to derive the energy spectrum of damping radiation in a general medium (including vacuum as a special case). The formulae are consistent with those of Bethe and Heitler for bremsstrahlung. J.W.Gardner

535.247.4

3119. MEASUREMENT OF THE OPTICAL DENSITY OF SMOKE IN A CHIMNEY. A.Littlewood.
J. sci. Instrum., Vol. 33, No. 12, 495-9 (Dec., 1956).

An instrument is described which was designed for the study of smoke emission from domestic-heating equipment, and its readings are independent of changes in the characteristics of the components and of variations in the electricity power supply. This is achieved by using a double-beam, null-balancing system with a single light source and a single barrier-layer photoelectric cell. A.

535.317.6

3120. NOTES ON THE INVESTIGATION OF THE POWERS OF THE LENSES IN A TRIPLET, FOLLOWING THE METHOD OF BEREK. C.Morais.
Atti Fond. Ronchi, Vol. 11, No. 2, 146-57 (March-April, 1956). In Italian.

Formulae are derived for the performance of a triplet lens with spaced components. A numerical example is given showing the application to the first-order design of such lenses. R.W.Fish

535.325 : 535.436 : 551.593

TABLES OF THE REFRACTIVE INDEX FOR STANDARD AIR. See Abstr. 2871.

535.329

3121. THE DRUDE DISPERSION FORMULA SHOWN TO BE APPLICABLE TO ANY MEDIUM IRRESPECTIVE OF THE POLARIZATION FIELD. K.S.Krishnan and S.K.Roy.
Phil. Mag. (Eighth Ser.), Vol. 1, 926-33 (Oct., 1956).

It is shown that the well known dispersion formula of Drude is applicable to a dense medium even when the polarization fields associated with the different types of oscillators may all be different. The parameters involved in the formula are naturally the frequencies and the oscillator strengths of the oscillators in the medium, both of them as influenced by the mutual interactions between the oscillators, i.e. as influenced by the polarization fields. The observed data on dispersion will enable us to determine these parameters. In the Lorentz type of dispersion formula, on the other hand, the frequencies and the oscillator strengths involved are those of the isolated oscillators, which naturally are independent of the polarization field, and hence the effect of the polarization field on dispersion has to be taken into account explicitly. Because of this, the Lorentz type of formula needs for its formulation explicit information regarding the polarization field, which cannot be supplied by the observed dispersion data alone. The reduction of the Drude formula

to one of the Lorentz type, and the appropriate information regarding the polarization field that is needed for this purpose, are also discussed in the paper. A.

535.33.07

3122. MULTIPLE-PATH TECHNIQUE FOR THE DETERMINATION OF PHYSICO-CHEMICAL DATA BEHIND SHOCK FRONTS. W.Hooker, M.Lapp, D.Weber and S.S.Penner.
J.chem. Phys., Vol. 25, No. 5, 1087 (Nov., 1956).

Describes apparatus, comprising a slotted air-turbine wheel making 120 000 rpm., similar to that used by Penner and Björnerud (Abstr. 2677/1955), for studying flame emission spectra, and now applied to study carbon formation and gas emissivities at high temperatures behind shock fronts by single- and double-path emission and absorption measurements. J.S.G.Thomas

535.33.07

3123. A MICROWAVE SPECTROGRAPH WITH AUXILIARY MODULATION. P.Favero and G.Grifone.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1174-89 (Nov., 1956). In Italian.

Description of a microwave spectrograph with auxiliary modulation of the source. The criteria are given for obtaining sensitivity and resolving power at $18\text{-}36 \times 10^9$ c/s. A.

535.331 : 535.343

3124. PHOTOCHEMICAL SEPARATION OF MERCURY ISOTOPES. I. A STUDY OF THE EMISSION AND ABSORPTION HYPERFINE LINES OF MERCURY AT 2537 A. K.R.Osborn, C.C.McDonald and H.E.Gunning.
J. chem. Phys., Vol. 26, No. 1, 124-33 (Jan., 1957).

An experimental and theoretical investigation has been made of the emission and absorption parameters in the excitation of Hg^{202} atoms in natural mercury to the $6(^3P_1)$ state by irradiation with the resonance line from an electrodeless discharge containing Hg^{202}. The absorption has been studied as a function of (a) absorption path length, (b) the concentration of mercury in the absorption cell, (c) the pressure of certain foreign gases in the absorption cell, (d) the operating temperature of the lamp, and (e) the type of excitor used with the lamp. The results of the study show that for the unique formation of $Hg^{202}6(^3P_1)$ atoms in natural mercury it is necessary to use a well-cooled source operating at the minimum power level consistent with steady radiation output. Furthermore, the pressure of foreign gas in the absorption cell must be kept low to eliminate Lorentz broadening effects on the absorption hyperfine line. It has been found that the emission line from an electrodeless discharge operated at 26° C, and excited by a 2450 Mc/s oscillator, can be satisfactorily represented as a Doppler line modified by self-absorption. For the calculation of the frequency distribution of the emission line, the Doppler temperature of the emitting gas and the equilibrium temperature of the mercury in the lamp were taken as identical with the lamp wall temperature (26° C). The optical thickness of the path of self-absorption was evaluated from the dimensions of the lamp. It was found that the observed absorptions could be calculated directly from the ratio of the areas of the Doppler absorption line of the Hg^{202} atoms in the absorption cell to that of the self-absorbed emission line. The agreement between theory and experiment is taken as evidence that only Hg^{202} atoms are undergoing excitation under the defined conditions. During the investigation the cross-sections for Lorentz broadening of hydrogen, methyl chloride and isopropyl chloride were determined with respect to the Hg^{202} absorption line. The values found were respectively 53.1, 192 and 297 x 10^{-16} cm^2. This study was undertaken as a precursor to a systematic investigation of the reactions of various substrates with photoexcited mercury isotopes. A.

535.331

3125. A METHOD OF DETERMINING OPTICAL CROSS SECTIONS. E.Hinnov.
J. Opt. Soc. Amer., Vol. 47, No. 2, 151-5 (Feb., 1957).

A method of evaluation of the optical cross-sections, i.e., cross-sections for broadening collisions between excited atoms and foreign molecules, from experimental intensity–density data is described. This method utilizes the analytical expressions of the asymptotes to the theoretical intensity–density curves at very low, and at very high densities of the emitting atoms. Only relative intensity measurements are necessary for the evaluation of the cross-sections. An intensity–density graph for the Na5890 line is constructed from photoelectric measurements of the total line intensities, emitted from a Lundegårdh-type acetylene-air flame. The optical cross-section for sodium corresponding to this line is found to be 64 square angstroms. A brief discussion of the possibilities of utilizing this method for the determination of the degrees of dissociation of metal salts in the flame, or the evaluation of absolute and relative f values of the spectral lines is included. A.

535.331

3126. OPTICAL CROSS SECTIONS FROM INTENSITY-DENSITY MEASUREMENTS. E.Hinnov and H.Kohn.
J. Opt. Soc. Amer., Vol. 47, No. 2, 156-62 (Feb., 1957).

Optical cross-sections corresponding to spectral lines of Li, Na, K, Ca, Sr, Ba, Tl, Cu, Ag, Cr, Mn, Fe, Co, and Ni, emitted by an acetylene–air flame, have been determined. The evaluation of the cross-section is based on intensity–density graphs, constructed from photoelectric measurements of the total line intensities as a function of the density of the emitting atoms in the flame. When the cross-section corresponding to the line has been determined, the measured intensity–density curves yield the absolute values of the product Nf of the number of atoms in the flame capable of absorbing the line, and the oscillator strength for the line. If the f-value for the line is known, the degree of dissociation of the element in the flame can be found. If the f-value for the line is not known, the product Nf allows, in some cases, the evaluation of the absolute f-value for the line; in other cases only a lower limit of the absolute f-value can be obtained. The results are compared with those of previous investigators. A.

535.331

3127. ISOTOPE SHIFTS AND HYPERFINE STRUCTURE IN THE ATOMIC SPECTRUM OF CADMIUM. H.G.Kuhn and S.A.Ramsden.
Proc. Roy. Soc. A, Vol. 237, 485-95 (Nov. 20, 1956).

The isotope shifts in the spark line λ 4416 of cadmium ($4d^{10}\,5p^2P_{3/2} - 4d^9\,5s^2\,^2D_{5/2}$) are accurately measured by means of single and double Fabry–Perot etalons and with the use of electromagnetically enrichted isotopes. The shifts between successive even isotopes are found to decrease with increasing neutron number in an irregular manner. Accurate values are obtained for the odd–even and odd–odd shifts in λ 4416; this involved the study of the h.f.s. of the lines λ 3250 and λ 3535. Pronounced odd–even staggering is found. Some conclusions on the change of nuclear deformation with neutron number are drawn and possible connections with shell structure discussed. A.

535.333

3128. EMISSION BAND SPECTRA OF NITROGEN. A STUDY OF SOME SINGLET SYSTEMS. A.Lofthus.
Canad. J. Phys., Vol. 35, No. 2, 216-34 (Feb., 1957).

Ten bands of Gaydon's and Herman's singlet systems and eight new bands have been photographed under high resolution and analysed in detail. Two of the new transitions were shown to be $^1\Sigma_u^+ - a\,^1\Pi_g$, the upper state being in one case identical with Watson's and Koontz's state g, and one new transition to be $^1\Delta_g - w\,^1\Delta_u$ in type. It is proposed that the new state $^1\Delta_g$ has the same electron configuration as the $x\,^1\Sigma_g^-$ state. Two bands in the red and one band in the ultraviolet could not be assigned with certainty. Local perturbations in the $p'\,^1\Sigma_u^+$ state were observed and shown to be caused by the v = 1 level of the $b'\,^1\Sigma_u^+$ state. Observed pecularities in the rotational structure of most of the upper states are proposed to be indicative of a transition from case b' to d' coupling. In some cases pronounced decreases in branch intensities were observed, indicating predissociations probably caused by "forbidden" intercombination processes. Identification of the electronic structure of the higher singlet states in terms of Rydberg orbitals is discussed. Rotational and vibrational constants and excitation energies are presented. A.

535.333

3129. ROTATIONAL ANALYSIS OF BANDS OF THE $A\,^3\Pi_0^+$, $B\,^3\Pi_1 - X\,^1\Sigma^+$ SYSTEMS OF GALLIUM MONOFLUORIDE. R.F.Barrow, P.G.Dodsworth and P.B.Zeeman.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 34-40 (Jan., 1957).

Rotational analyses of the 0, 0 band of the A–X system and of the 0,0 and 0,1 bands of the B–X system, for both molecules $Ga^{69}F$ and $Ga^{71}F$, have been made. The internuclear distance r_e'' in the ground state is 1.775 A; the energy of dissociation D_0'' (for $Ga^{69}F$) is found to be $143._3$ kcal $mole^{-1}$. A.

535.333

3130. THE EMISSION SPECTRUM OF AlF IN THE VACUUM ULTRAVIOLET. S.M.Naudé and T.J.Hugo.
Canad. J. Phys., Vol. 35, No. 1, 64-70 (Jan., 1957).

Two vacuum ultraviolet band systems of aluminium monofluoride, the $B^1\Sigma^+$-$X^1\Sigma^+$ and $C^1\Sigma^+$-$X^1\Sigma^+$ systems, are described. The rotational analyses of a few bands in each system are given and the rotational and vibrational constants of the $X^1\Sigma^+$ and $B^1\Sigma^+$ electronic states are determined. Accurate T_e-values for the $A^1\Pi$, $B^1\Sigma^+$, $C^1\Sigma^+$, and $D^1\Delta$ states are given. A.

535.333

3131. THE SPECTRUM OF SILICON HYDRIDE. A.E.Douglas.
Canad. J. Phys., Vol. 35, No. 1, 71-7 (Jan., 1957).

The 0—0, 1—0, 2—1, and 2—2 bands of the $^2\Delta-^2\Pi$ band system of SiH have been photographed under high dispersion and analysed. The vibrational and rotational constants have been determined and the dissociation energy has been found to be 3.19 ± 0.25 eV. A list of SiH lines which may occur as interstellar absorption lines is given. A.

535.338.33 : 539.152.1

3132. NUCLEAR ISOMERIC SHIFT ON SPECTRAL LINES. R.Weiner.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1587-9 (Dec., 1956).

A theoretical calculation of the interaction of orbital electrons with the internal nuclear structure is used to predict a spectroscopic isotopic shift in the $_{49}In^{115}$ III spectrum of $\sim 5 \times 10^{-2}$ cm^{-1} between the $1g_{1/2}$ and $2p_{1/2}$ nuclear states. D.H.Whiffen

535.338.4 : 535.352 : 537.525

3133. THE INFLUENCE OF ELECTRON CONCENTRATION ON THE PROBABILITY OF FORBIDDEN TRANSITIONS. H.Schram and L.Herman.
Appl. sci. Res. B, Vol. 5, No. 1-4, 57-8 (1955). In French.

A brief note describing measurements on nitrogen diluted with xenon (55 mm Hg pressure). Probe measurements of the electron temperature and density were made. Optical measurements gave the probability of the forbidden transition $A^3\Sigma_u^+ - X^1\Sigma_g^+$. A brief theoretical treatment of the data is given. J.D.Craggs

535.338.41 : 535.39

3134. SELECTIVE REFLECTION FROM MERCURY VAPOR AT HIGH PRESSURES. J.A.Galt and H.L.Welsh.
Canad. J. Phys., Vol. 35, No. 1, 98-113 (Jan., 1957).

Selective reflection from mercury vapour in the region of the 2537 A resonance line was investigated at pressures up to 340 atm using reflection cells of special design. The results were interpreted on the basis of the classical theory of reflection from an absorbing medium. By fitting calculated curves to the experimental reflection contours, values of the oscillator strength, f, and the damping constant, γ, were determined. The f values so obtained are density-dependent and at high pressures are approximately equal to one half the value for the free atom. As predicted by theory, the damping constant varies directly as the density of the atoms in the vapour. This result contradicts the earlier work of Welsh, Kastner, and Lauriston (1950) in which it was concluded that γ varies as the square root of the density. A subsidiary reflection maximum was observed at 2540 A; it is attributed to Hg_2 molecules which occur in relatively large concentrations at high densities. Some preliminary observations on the selective reflection at the 1850 A resonance line were made up to 4.4 atm. A.

535.338.41 : 535.39

3135. INFLUENCE OF FOREIGN GASES AT HIGH PRESSURES ON THE SELECTIVE REFLECTION FROM MERCURY VAPOR. J.A.Galt and H.L.Welsh.
Canad. J. Phys., Vol. 35, No. 1, 114-21 (Jan., 1957).

The influence of the foreign gases hydrogen, helium, nitrogen, and argon on the selective reflection from mercury vapour at 2537 A was studied at pressures up to 1500 atm. The results were interpreted on the basis of the classical theory of reflection from an absorbing medium. The damping constant was found to vary linearly with foreign gas density as predicted by collision broadening theory. Frequency shifts and collision diameters determined from selective reflection data agree fairly well with values measured in absorption by other workers. A.

535.34.07

3136. A DOUBLE-BEAM MICROSPECTROMETER. G.H.Haggis.
J. sci. Instrum., Vol. 33, No. 12, 491-3 (Dec., 1956).

A modified single-beam spectrometer, fitted with a small rocking mirror to provide a double-beam through a reflecting microscope, is described. The ratio of the intensities of the two beams is determined electronically, and fed through to a pen recorder. The merits of this arrangement are compared with those of other micro-double-beam systems. A.

535.34.07

3137. PLANE PARALLEL PLATE TRANSMISSION LINE STARK MICROWAVE SPECTROGRAPH. S.A.Marshall and J.Weber.
Rev. sci. Instrum., Vol. 28, No. 2, 134-8 (Feb., 1957).

A parallel plane transmission system is described for use in high Stark field microwave spectroscopy. The planes of the system are optically flat silvered glass plates and are separated by plane parallel fused quartz spacers. The instrument gives intense sharp lines out to Stark field strengths of the order of 25 statvolts/cm. A.

535.343 : 548.7

3138. REFLECTION SPECTRUM AND STRUCTURE IN THE EXCITON ABSORPTION PEAK OF NaCl AND KCl. P.L.Hartman, J.R.Nelson and J.G.Siegfried.
Phys. Rev., Vol. 105, No. 1, 123-30 (Jan. 1, 1957).

Measurements in the vacuum ultraviolet have been made on the transmission of thin films of NaCl and KCl and on the reflectivity of single crystals of these same salts. Comparison is made between the two types of measurements and with the absorptions measured in thin films by Schneider and O'Bryan. The agreement with the latter in the case of NaCl is good only over the region of the first absorption while in the case of KCl it is good over the whole region over which the measurements overlap. A new absorption is found in NaCl near 1100 A and in KCl just below 1000 A. In both salts the first fundamental absorption near 1600 A, presumed to be that of the exciton, as inferred from the reflectivity is at least a doublet at liquid nitrogen temperatures; but further multiplicity of the type predicted by Overhauser is not established, although possibly indicated. Absolute reflectivities of the order of 60% are measured at low temperatures. A.

535.343

3139. FINE STRUCTURE ANALYSIS OF NO [NITRIC OXIDE] ABSORPTION BANDS IN THE SCHUMANN REGION. R.F.Barrow and E.Miescher.
Proc. Phys. Soc. A, Vol. 70, Pt 3, 219-22 (March, 1957).

Rotational analyses of bands in the far ultraviolet absorption spectrum of nitric oxide have been carried out. The bands studied include the 0,0, 1,0, 2,0, 3,0 and 4,0 bands of the ϵ-system ($D^2\Sigma^+ - X^2\Pi$), the 4,0 and 5,0 bands of the γ-system ($A^2\Sigma^+ - X^2\Pi$), and the 8,0, 13,0 and 17,0 bands of the β-system ($B^2\Pi - X^2\Pi$), as well as other bands ascribed to new systems. Summaries are given of the constants for the states $A^2\Sigma^+$, $B^2\Pi$ and $D^2\Sigma^+$. All bands in the absorption spectrum above 1600 A have now been assigned. Possible Rydberg series are briefly discussed. A.

535.343 : 539.133

3140. NEAR ULTRAVIOLET SPECTRUM OF CRYSTALLINE HEXAMETHYL BENZENE AND THE STRUCTURE OF THE HEXAMETHYL BENZENE MOLECULE. O.Schnepp and D.S.McClure.
J. chem. Phys., Vol. 26, No. 1, 83-92 (Jan., 1957).

The absorption and fluorescence spectra of single oriented crystals of hexamethyl benzene were photographed at high resolution with polarized light at 20°K in the 2800 A region. The analysis shows that the 0—0 transition is observed with much greater intensity in light polarized perpendicular to the plane of the benzene ring than in light polarized in this plane. In the perpendicular component the vibrational structure of a weak allowed transition appears together with the 0—0 band. The in-plane spectrum is a forbidden transition, similar to the benzene 2600 A absorption. A detailed calculation shows that the pertubation by the crystal lattice cannot be the cause of the observed behaviour of the 0—0 band in polarized light. It is concluded, therefore, that this behaviour must be caused by the lowering of the molecular symmetry by the methyl groups. The probable symmetry of the molecule is S_6. This symmetry approximately fixes the positions of the hydrogen atoms and determines the shape of the methyl rolling potential. A.

535.343

3141. ELECTRONIC SPECTRA OF HYDROCARBON ANIONS. N.S.Hush and J.R.Rowlands.
J. chem. Phys., Vol. 25, No. 5, 1076-7 (Nov., 1956).

The absorption spectra (4000 - 10 000 A) of the monosodium salts of naphthalene, anthracene, diphenyl, phenanthrene and pyrene in tetrahydrofurane solution (10^{-4} - 10^{-5} molar) at room temperature are reported. The observed transitions are attributed to symmetry-allowed doublet—doublet transitions. Only sodium anthracene shows marked vibrational structure, namely one partially- and five clearly-resolved bands in the visible region with an average separation of 1470 cm^{-1}. G.Allen

535.343

3142. ABSORPTION SPECTRA OF SOLVATED ANIONS. M.Smith and M.C.R.Symons.
J. chem. Phys., Vol. 25, No. 5, 1074-5 (Nov., 1956).

Two broad bands in the 200 μ region are observed in the spectrum of I^- in dilute aqueous solution, as the result of charge

transfer to solvent. Variation of temperature, ionic strength and solvent shifts the low energy band within the limits 210-260 μ. A correlation of the shifts is obtained by assuming that in the excited state the electron is held in a potential well defined by the oriented solvent molecules, and the charge transfer to solvent spectrum of any ion should show these features. OH^-, Cl^- and Br^- ions do, but MnO_4^-, IO_3^- and CrO_4^- are relatively inert to the same changes. The 2147 A band of the aqueous thiosulphate is sensitive to environmental changes and it suggests that the changes are not due solely to ion pairing. G.Allen

535.343

3143. INFRARED ABSORPTION BY THE N_3 RADICAL. D.E.Milligan, H.W.Brown and G.C.Pimentel.
J. chem. Phys., Vol. 25, No. 5, 1080 (Nov., 1956).

The infrared spectrum of the products condensed at 4°K from a glow discharge in N_2 is reported. Each of three experiments gives a condensed film which absorbs at 2150 cm^{-1}, and in two of them bands are also observed at 962 and 737 cm^{-1}. The bands disappear at 35°K and are attributed to an unstable species. The 2150 cm^{-1} band is assigned as the asymmetric stretch of a linear N_3 radical, and an experiment using N^{15} gives evidence that the species absorbing at 2150 cm^{-1} contains nitrogen. The 962 and 737 cm^{-1} bands are tentatively assigned to polymeric species higher than N_3 although the 737 cm^{-1} band could be the degenerate bending mode of N_3. It is unlikely that N atoms are trapped in the solid nitrogen because of the apparent stability of N_3. G.Allen

535.343 : 539.133

3144. VIBRATIONAL SPECTRA AND STRUCTURE OF SOLID SULFAMIC ACID AND THE SULFAMATE ION. A.M.Vuagnat and E.L.Wagner.
J. chem. Phys., Vol. 26, No. 1, 77-82 (Jan., 1957).

The infrared spectra of finely powdered samples in pressed disks of KBr have been obtained for sulphamic acid, sodium and potassium sulphamates, and the corresponding deutero-compounds in the region from 4000 to 500 cm^{-1} at several temperatures. Satisfactory vibrational assignments could be made for the zwitterion model of the acid, $H_3N^+\text{-}SO_3^-$, with site symmetry in the crystal of C_1 in agreement with X-ray data. The sulphamate ion spectra can satisfactorily be interpreted on the basis of the C_s model, $H_2NSO_3^-$. The N–S stretching modes were found at somewhat lower frequencies than previously postulated, 682 and 790 cm^{-1}, respectively, for the acid and salt. A.

535.343

3145. MICROWAVE SPECTRUM OF β PROPIOLACTONE. N.Kwak, J.H.Goldstein and J.W.Simmons.
J. chem. Phys., Vol. 25, No. 6, 1203-5 (Dec., 1956).

The microwave spectrum of propiolactone has been studied in the 18-34 kMc/s region. Analysis of the data obtained leads to the conclusion that the ring is planar and $\angle HCH = 112^0$. Satellite spectra are observed and attributed to the out-of-plane ring bending mode with a first excited state 120 cm^{-1} above ground. Quantitative Stark effect studies support the planarity assumption and lead to a dipole moment of 4.18 ± 0.04 d. The possible orientations of the dipole are considered. A.

535.345 : 537.312.5

3146. ABSORPTION AND PHOTOCONDUCTIVITY DETECTION SYSTEM FOR A BAUSCH AND LOMB GRATING SPECTROMETER. W.M.Baker and S.J.Czyzak.
Amer. J. Phys., Vol. 24, No. 7, 524-5 (Oct., 1956).

A crystal whose photoconductivity is to be determined is mounted behind the exit slit, and behind the crystal there is a thermopile, so that a simultaneous measurement of intensity may be made. G.F.Lothian

535.345

3147. OPTICAL ABSORPTION BY SILVER HALIDES. S.Tutihasi.
Phys. Rev., Vol. 105, No. 3, 882-4 (Feb. 1, 1957).

The absorption spectra of silver chloride, silver bromide, and silver iodide films evaporated on quartz plates have been measured at room temperature and liquid nitrogen temperature. It has been found that the "exciton peaks", which have been believed to depend very little upon temperature, become sharper and shift toward the shorter wavelength side as the films are cooled down to liquid nitrogen temperature. Attempts are made to combine the present data with some published data to give absorption curves for silver chloride and silver bromide over a large range of absorption spectrum at room and low temperatures. A.

535.345.6

3148. DISPERSED LIGHT FILTERS OF HIGH MONOCHROMATICITY. F.A.Korolev and A.Yu.Klement'eva.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1025-7 (1954). In Russian.

For many applications where a monochromator is not convenient these filters may prove useful. The principle of action is that explained by Christiansen (1884). For the visible region a compact powder of optical glass (dimensions 0.1 to 0.2 mm dia.) is in a glass container, the intermediate space being filled by an organic fluid. Such filters are examined both experimentally and theoretically. The variation in the wavelength transmitted with temperature is shown. An improvement in both monochromaticity and contrast may be obtained by combining filters. Figures are quoted for two single filters and for both together in series. With a diameter of 0.4mm and a thickness of 13mm, the halfwidth at 5194 A was 38 A for one and 45 A for the other. When combined the halfwidth was reduced to 22 A. W.Bardsley

535.35 : 535.338.3

3149. RENEWED MEASUREMENT OF EXCITATION FUNCTIONS. J.A.Smit and H.M.Jongerius.
Appl. sci. Res. B, Vol. 5, No. 1-4, 59-62 (1955).

Describes an experimental arrangement using photomultiplier tubes and modern techniques and gives experimental results for several Hg lines. Comparison with earlier work revealed appreciable differences. J.D.Craggs

535.37 : 537.312.5

LUMINESCENCE AND PHOTOCONDUCTIVITY OF VARIOUS PHOSPHORS. See Abstr. 2248-9

535.37 : 539.166.08 : 539.165.08

$CaSO_4$(Mn) PHOSPHOR. See Abstr. 2592

535.37 : 541.128

LUMINESCENCE AND CATALYTIC PROPERTIES OF ZINC OXIDES AND SULPHIDES. See Abstr. 2770

535.371 : 548.7

LUMINESCENCE IN SINGLE CRYSTALS OF LANTHANUM TRICHLORIDE CONTAINING DIPOSITIVE EUROPIUM. See Abstr. 2828

535.372 : 535.343

3150. ON THE POSSIBILITY OF TRANSITION OF ONE KIND OF CONCENTRATION QUENCHING OF FLUORESCENCE TO ANOTHER. B.Ya.Sveshnikov, L.A.Kuznetsova and V.A.Molchanov.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 4, 746-9 (1956). In Russian.

The influence of concentration on the luminescence of acridine orange has been investigated both at room temperature and at liquid air temperature. The absorption spectrum and the fluorescence spectrum are plotted for concentrations of 1×10^{-5}, 1×10^{-4}, 1×10^{-3} and 2.5×10^{-2} mol/l., as also are the relative output and duration. Three possible hypotheses to account for the results are discussed. W.Bardsley

535.372

3151. THE ORIGIN OF THE INFRA-RED EMISSION BANDS IN ZINC AND CADMIUM SULPHIDE PHOSPHORS. P.F.Browne.
J. Electronics, Vol. 2, No. 1, 95-7 (July, 1956).

The infrared emission and excitation spectra of CdS, ZnS-CdS and related phosphors have been studied. From the experimental data, it is proposed that the infrared emission bands arise from transitions of electrons excited into unoccupied centres (probably cation vacancies) from the valence band in returning thereto. J.B.Birks

535.372

3152. EMISSION AND EXCITATION SPECTRA OF THALLIUM-ACTIVATED POTASSIUM CHLORIDE AT LOW TEMPERATURES. D.A.Patterson and C.C.Klick.
Phys. Rev., Vol. 105, No. 2, 401-6 (Jan. 15, 1957).

Measurements are reported on the emission spectrum and excitation spectrum. The emission spectra derived from Williams' computed configuration coordinate curves are not in close agreement with those observed experimentally. It is shown that the simple one-dimensional treatment of the configuration coordinate curves cannot account for all the absorption and emission data in a self-consistent way. At 300°K and 77°K the excitation spectra for the 3050 A emission and the 4750 A emission are found to be different. It is suggested that these two emissions may arise from different thallium centres rather than from two excited states of the same centre as proposed by Johnson and Williams. A.

535.373

3153. THE EFFECT OF ADSORBED WATER ON THE PHOSPHORESCENCE OF SODIUM ACETATE. K.Osada.
J. Phys. Soc. Japan, Vol. 11, No. 9, 1014-15 (Sept., 1956).

535.375.5

3154. THE RAMAN SPECTRUM OF CYCLOPROPANE.
P.M.Mathai, G.G.Shepherd and H.L.Welsh.
Canad. J. Phys., Vol. 34, No. 12B, 1448-59 (Dec., 1956).

The Raman spectra of gaseous and liquid cyclopropane were examined with high spectrographic dispersion. The resolved rotational spectrum of the gas gave $B_0 = 0.6697 \pm 0.0005$ cm^{-1}. Although no rotational structure in the vibrational bands was resolved, the spectrum of the gas clarifies the frequency assignments. Nine of the ten Raman active frequencies were recorded; of particular interest are $\nu_1 = 3038.0$, $\nu_8 = 3019.9$, and $\nu_{13} = 1188.0$ cm^{-1}. The inactive frequency ν_4 was assigned to a faint line at 1132.5 cm^{-1}. The constants of some of the degenerate vibrations were determined from the intensity contours of the bands. Comparison of the spectrum of the liquid with that of the gas shows how the former has led to incomplete vibrational assignments. A.

535.375.5

3155. RAMAN SPECTRUM OF THIONYL BROMIDE.
H.Stammreich, R.Forneris and Y.Tavares.
J. chem. Phys., Vol. 25, No. 6, 1277-8 (Dec., 1956).

Observed frequencies, estimated intensities, and suggested assignments of the Raman lines are tabulated. Four polarized shifts and two depolarized shifts indicate a pyramidal structure with the S and O atoms normal to the SBr_2 plane. This supports electron diffraction data. G.I.W.Llewelyn

535.375.56

3156. THE RAMAN SPECTRUM OF ACETYLENE. T.Feldman, G.G.Shepherd and H.L.Welsh.
Canad. J. Phys., Vol. 34, No. 12B, 1425-30 (Dec., 1956).

The rotational and rotation–vibrational Raman spectra of acetylene at one atmosphere pressure were investigated with high spectrographic dispersion. The rotational structures of the three Raman-active fundamentals, ν_1, ν_2, and ν_4^1, were resolved and analysed. The band origins, rotational constants, and certain anharmonicity coefficients were derived. A.

535.375.56

3157. THE RAMAN SPECTRUM OF DIDEUTEROACETYLENE.
L.Krause and H.L.Welsh.
Canad. J. Phys., Vol. 34, No. 12B, 1431-5 (Dec., 1956).

The rational and rotation–vibrational Raman spectra of dideuteroacetylene were photographed at one atmosphere pressure with high spectrographic dispersion. The rotational structure of the ν_4^1 band was resolved and analysed, but only the Q branches of the ν_1 and ν_2 bands were observed. A.

535.375.56 : 539.132

3158. RAMAN SPECTRUM AND VIBRATIONAL ASSIGNMENTS OF GASEOUS DIMETHYL ETHER. R.C.Taylor and G.L.Vidale.
J. chem. Phys., Vol. 26, No. 1, 122-3 (Jan., 1957).

The Raman spectrum of gaseous dimethyl ether has been obtained and that of the liquid reinvestigated. In the low-frequency region of the gas spectrum, two bands have been observed which are attributed to overtones of the torsional motions of the methyl groups. The assignment of vibrational frequencies is discussed on the basis of a C_{2v} symmetry in the molecule. A.

535.376

3159. THE EFFICIENCY OF ELECTROLUMINESCENCE.
W.Lehmann.
Illum. Engng, Vol. 51, No. 10, 684–8 (Oct., 1956).

The luminous efficiency (lumens/watt) of electroluminescence of powdered phosphors excited by an alternating voltage is dependent on amplitude and on frequency of the exciting voltage. Increasing voltage causes first an increase of efficiency and then, for higher voltages, a decrease. The peak efficiency and the electroluminescent brightness are connected with each other by some simple laws, which are discussed. With constant voltage but variable frequency, the efficiency is nearly independent of frequency for some phosphors, but very dependent on frequency for other phosphors. A.

535.376

3160. SECONDARY WAVES OF ELECTROLUMINESCENCE.
C.H.Haake.
J. appl. Phys., Vol. 28, No. 1, 117-23 (Jan., 1957).

Secondary waves of electroluminescence exhibit specific trends with varying frequency and temperature. As has been assumed before, secondary waves are caused by effects of charge polarization inside the phosphor crystals; however, there has been no previous theoretical approach to this problem which leads to a description of the behaviour of secondary waves with respect to frequency and temperature. An attempt has therefore been made to treat this phenomenon mathematically, using a simple model of charge polarization. During electroluminescent excitation conduction electrons are drawn to the anodic crystal parts where they become trapped. When the alternating field externally applied passes zero these electrons, under the influence of a polarization field, may return to luminescence centres and thus give rise to light emission. The return process depends on the trap depth, the temperature, the applied external field, and its frequency. This model can indeed describe the observed behaviour, so that there seems to be little doubt as to the actual origin of secondary waves. As an interesting corollary of these considerations, the occurrence of secondary waves may be a means for determining electron trap depths and for detecting shallow traps where "glow curves" fail. A.

535.376

3161. HIGH-FREQUENCY-INDUCED ELECTROLUMINESCENCE IN ZnS. G.G.Harman and R.L.Raybold.
Phys. Rev., Vol. 104, No. 6, 1498-9 (Dec. 15, 1956).

A brief presentation of data is given for electroluminescent measurements made on several ZnS crystals over a frequency range of 1 c/s to 370 Mc/s. Electroluminescent relaxation becomes apparent in the order of 10^5–10^6 c/s. A simple exponential equation, $I = A(V-V_0)^B$, was found to fit the time-average electroluminescent intensity v. voltage over four decades of intensity. A.

535.376

3162. LOW-FIELD ELECTROLUMINESCENCE IN INSULATING CRYSTALS OF CADMIUM SULFIDE. R.W.Smith.
Phys. Rev., Vol. 105, No. 3, 900-4 (Feb. 1, 1957).

Green electroluminescence can be obtained from insulating crystals of CdS at low d.c. fields. The wavelength of the emitted light corresponds to the energy of the gap between the valence and conduction bands. The emission band and the optical absorption edge shift together with temperature. The emission of light is correlated with an abrupt increase in current through the crystal, and the intensity is proportional to it. The measured electric field in the region of the crystal where light is generated is ~ 1000 V/cm. The pattern of the electroluminescence (beams) is deflected by an 8000 gauss magnetic field. The experiments can be explained by the hypothesis that conduction occurs because of injection of free carriers into the insulator by the electric field, electrons from the cathode and holes from the anode. The luminescence results from the recombination of the injected holes and electrons which have drifted into the bulk of the crystal. A.

535.376

3163. ELECTROLUMINESCENCE OF SEMICONDUCTING DIAMONDS. R.Wolfe and J.Woods.
Phys., Rev., Vol. 105, No. 3, 921–2 (Feb. 1, 1957).

Electroluminescence has been observed in Type IIb diamonds. With both alternating and direct current, the light is emitted in the vicinity of a point contact electrode when this electrode is negative. The spectrum consists of a single broad band centred at 4400 A. The variation of the electroluminescent intensity with current voltage and frequency is reported. This behaviour is typical of carrier-injection electroluminescence. A.

535.376

3164. CRYSTAL MOUNT AND TECHNIQUES FOR MEASURING HIGH-FREQUENCY-INDUCED ELECTROLUMINESCENCE.
G.G.Harman.
Rev. sci. Instrum., Vol. 28, No. 2, 127-9 (Feb., 1957).

A versatile apparatus is described for use in studying electroluminescence and electrophotoluminescence. Measurements of light emission can be made with electrical excitation frequencies ranging from d.c. to 400 Mc/s and also in selected microwave bands. Oscillators that may be employed over this frequency range are discussed. The apparatus consists of a crystal mount and a simple optical system for irradiation and for the separation of excitation and luminescent spectra. Flat plate-type as well as long sliver-type crystals are mounted on slides which can be easily interchanged. Tests may be run from low temperatures (–70°C or lower) up to about 300°C. A.

535.391

3165. THE SPECTRUM OF REFLECTION AND TRANSMISSION OF DIFFERENT MODIFICATIONS OF SILICA IN THE WAVE-LENGTH REGION 7-24μ. N.A.Sevchenko and V.A.Florinskaya. Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1115-18 (1956). In Russian.

The behaviour of α-quartz, and fused quartz in the region 1-15 μ has been extensively studied, but information at longer wavelengths is restricted. For a study of silica glasses it is important to know the complete spectrum of all forms of quartz. A reflecting monochromator with alternative prisms (for 7-14μ rock salt; for 14-24μ 60^0 angle KBr) was used. The following types of silica were examined: (a) in reflection, α-quartz, both parallel and perpendicular to the optic axis, crystobalite, and Hereus fused silica; (b) in transmission, α-quartz, α-tridymite, α-crystobalite, and Hereus fused silica. The curves are plotted in each case and a table of observed peaks is given. W.Bardsley

535.391

3166. THE TRANSMISSION, ABSORPTION AND REFLECTION OF SOLAR RADIATIONS BY GLASSES. A.Ram and S.N.Prasad. J. sci. industr. Res., Vol. 14A, No. 12, 570-84 (Dec., 1955).

Reviews the absorption bands of the oxides used in glasses for producing high or low transmissions in various parts of the wavelength region 0.2-5μ. The effect of oxidation of ferrous and other oxides by ultraviolet radiation in changing the transmission of a glass is discussed. The colouring effects of colloidal copper, cadmium sulphide and cadmium selenide are described. 33 spectral transmission curves of commercial and experimental glasses are given, together with 39 references. G.F.Lothian

535.393 : 539.234

3167. REFLECTANCE OF EVAPORATED ALUMINUM IN THE VACUUM ULTRAVIOLET. G.Hass, W.R.Hunter and R.Tousey. J. Opt. Soc. Amer., Vol. 46, No. 12, 1009-12 (Dec., 1956).

The effect of speed of evaporation, pressure, thickness, and age on the reflectance of evaporated Al films was investigated in the extreme ultraviolet from 900 A to 2200 A. High speed of evaporation was found to be the most important factor in producing Al films of highest ultraviolet reflectance. By changing the evaporation time required to produce an 800 A thick coating from 2 sec to 130 sec at a pressure of 1×10^{-5} mm Hg, the reflectance is reduced from 90% to 67% at 2000 A, from 74% to 50% at 1600 A, and from 38% to 30% at 1200 A. For films produced at higher pressures such as 1×10^{-4} mm Hg the effect of evaporation speed on the reflectance is even more pronounced. Film thickness has very little effect on the reflectance as long as films are not thinner than 400-500 A and not thicker than 2000 A. The effect of ageing on the reflectance increases strongly with decreasing wavelength. Between 2 hr and 1 month exposure to air the reflectance of good Al films decreases from 91.5% to 90.0% at 2200 A, from 75% to 69% at 1600 A, and from 44% to 27% at 1200 A. A.

535.393 : 537.311.11

TRANSPARENCY OF FILMS OF ALLOYS Mg–Sb, Mg–Bi, Mg–Sn. See Abstr. 2186

535.41

3168. INTERFERENCE IN AN OPTICAL WEDGE. U.Oppenheim and J.H.Jaffe. Amer. J. Phys., Vol. 24, No. 9, 610-15 (Dec., 1956).

Many standard textbooks treat interference in an optical wedge quite inadequately. Elementary treatments of this problem often leave much confusion about the exact conditions under which the fringes are formed and observed. Here a unified introductory treatment is presented both for two-beam and multiple-beam interference. Special attention is given to the localization of the fringes around the wedge. Factors governing the fringe visibility are examined. A.

535.412 : 771.534.57

3169. SOLARIZATION TECHNIQUE FOR INTERFEROGRAMS. C.E.Arregger. J. sci. Instrum., Vol. 33, No. 10, 406 (Oct., 1956).

The fringes obtained with two-beam interferometers for examining surface topography can be sharpened on the photographic plate by means of a photocopying technique which is described. S.Tolansky

535.412

3170. INTERFERENCE PHENOMENA EXHIBITED BY FRESNEL MIRRORS DISPLACED FROM ONE ANOTHER. K.Kempni and M.Haber. Period math.-phys.-astron.[Zagreb], Vol. 11, No. 1, 53-65 (1956). In German.

Complex interference phenomena are exhibited if the two mirrors in a Fresnel's mirror arrangement (which normally touch) are separated. In the main, additional diffraction maxima and minima superpose themselves upon the interference pattern. These originate from diffraction at the mirror edges, and the two systems diffraction and interference cannot be separated. In the shadow region of the diffracted light there is also an interference system. The observations are illustrated by photographs. The theory is discussed. S.Tolansky

535.417 : 539.234

3171. THICKNESS CONTROL OF THIN LAYERS. A.C.S.van Heel. Canad. J. Phys., Vol. 34, No. 12B, 1460-5 (Dec., 1956).

Observation of path differences by means of an interferometric arrangement making use of birefringent crystals has been described by Françon. Important advantages of the method are the fact that the interferometric part is concentrated in the eyepiece, and its ruggedness, the interference taking place within the crystal plates. It can therefore be adapted to other purposes than microscopic observation. Only those objects that are lying within the depth limits of the field give an observable effect. With the use of a large aperture object glass, this depth can be kept within narrow limits. Thus the effect of phase objects outside the sharp field is of no or slight influence. This means that the object to be studied can be placed between glass plates of bad quality. In consequence we can measure the thickness of coatings in a vacuum, that is, during the operation of evaporation. The light enters and leaves the vacuum vessel through windows of thick plate glass. The light source and the interference eye-piece are mounted outside the vessel. The measurement of the thickness of the coating is effected by means of a plane-parallel glass plate, placed in a non-parallel part of the light pencil. With white light the field is divided in sections of different colours, which may serve to measure the thickness of the layer (with reference to a screened part of the same surface on which no layer is formed). A better way is to observe in monochromatic light. It proved possible to measure simultaneously the thickness and the absorption of a layer. A.

535.417 : 531.715

3172. A KÖSTERS-TYPE INTERFEROMETER. C.F.Bruce. J. sci. Instrum., Vol. 33, No. 12, 478-82 (Dec., 1956).

The design and performance are described of a Kösters-type interferometer which measures lengths of up to 500 mm directly by interferometry. Isotopic light sources are necessary for the measurement of the longer lengths, and sources containing Hg^{198} and Kr^{86}, as well as natural krypton and cadmium, have been used with this interferometer. Results of some length and relative wavelength measurements are given, to illustrate the performance of the interferometer operating in air and in vacuo. A.

535.42

3173. ON INTEGRALS OCCURRING IN THE VARIATIONAL FORMULATION OF DIFFRACTION PROBLEMS. A.T.de Hoop. Proc. K. Ned. Akad. Wetensch. B, Vol. 58, No. 4, 325-30 (1955).

Expansions are given in a series of powers of ka of the integral occurring in the case of a circular aperture of radius a, and in a series of powers of kb for an infinite slit of width 2b ($k = 2\pi/\lambda$). L.Pincherle

535.42

3174. VARIATIONAL FORMULATION OF TWO-DIMENSIONAL DIFFRACTION PROBLEMS WITH APPLICATION TO DIFFRACTION BY A SLIT. A.T.de Hoop. Proc. K. Ned. Akad. Wetensch. B, Vol. 58, No. 5, 401-11 (1955).

An aperture is considered in a perfectly conducting plane screen of vanishing thickness. The aperture, which may consist of a number of separate parts, has boundaries parallel to the y axis. If only the y-component of either E or H is different from zero, the total field is independent of y, and the solution of the diffraction problem is reduced to the determination of two quantities which satisfy the two-dimensional wave equation, the boundary and edge conditions at the screen, and suitable conditions at infinity. It is shown that, for an incident plane wave, at any angle of incidence, the (complex) amplitude a of the far-zone diffracted field can be written in a stationary form of well known type. This formulation is applied to an infinite slit of finite width 2b. The transmission coefficient and a are determined up to terms of order $(kb)^4$, where $k = 2\pi/\lambda$. L.Pincherle

535.43

3175. LIGHT SCATTERING BY GLASSES. R.D.Maurer. J. chem. Phys., Vol. 25, No. 6, 1206-9 (Dec., 1956).

Previous light scattering investigations have shown that glasses contain inhomogeneities other than density fluctuations from room temperature agitation. These inhomogeneities were investigated by

measuring the scattering by several types of commercial optical glass. For most glasses the angular variation of intensity was the same as scattering by a distribution of randomly oriented, anisotropic centres that are small compared to a wavelength of light. This is the same angular variation found for liquids. The scattered intensity was changed by annealing, showing that the inhomogeneities originate with the frozen liquid state. The data may be explained by assuming that the inhomogeneities are principally thermal fluctuations in the liquid which are frozen into the glass at high temperatures. A.

535.43

3176. MULTIPLE SMALL ANGLE SCATTERING OF WAVES BY AN INHOMOGENEOUS MEDIUM. P.Gosar.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 688-702 (Oct., 1956).

Proceeding from the scalar wave equation the problem of the multiple small-angle scattering by an inhomogeneous medium with very small fluctuations of the refractive index is solved. The theory involves an extension of the work of Debye and Bueche on the scattering of light by an amorphous solid for the case where the Rayleigh–Gans–Born approximation is no more valid. A generalized autocorrelation function $\gamma(r, s)$ takes into account the phase-shift of the plane light-wave passing through the particular fluctuation of the refractive index. It is a function of the correlation distance vector r and of the unit wave-normal s. The theory is applicable to dense systems where "corpuscular" theories fail. A.

535.43.07

3177. APPARATUS FOR OPTICAL CLARIFICATION APPLIED IN LIGHT SCATTERING PHOTOMETRY. J.Szanto.
Naturwissenschaften, Vol. 43, No. 16, 373 (1956).

The solution is passed through a Schott G5 sintered glass filter into a container which is then used as an optical cell for making the turbidity measurements. J.W.T.Walsh

535.43.07

3178. COMPARISON TYPE NEPHELOMETER. W.F.Wright.
Rev. sci. Instrum., Vol. 28, No. 2, 129-34 (Feb., 1957).

A comparison type nephelometer has been designed and constructed with which turbidities are measured by both absorption and scattering of light. The especially designed cells permit accurate measurement of small changes in intensity of either transmitted or scattered light over a wide range of intensities. A single light source with a sector scanner alternately illuminates two separate optical paths for simultaneous comparison of two cells, one of which may be standard. The intensities of the two optical paths can be varied independently for comparison measurements. A light integrating sphere with phototube assembly furnishes a single photoreceiver for the two optical paths. One such sphere compares the transmitted beams, another, the scattered beams. The reproducibility of resetting in the normal operating range is two parts in ten thousand. The apparatus will operate over a range of more than five density units. When making series of measurements, it was found possible to make and record readings for different cells every 15 sec. The apparatus was used successfully for two years in bacteriological, silica gel, and colorimetry studies. A slight modification permits measurement of the depolarization of the scattered light as well as the usual Tyndall scattering. This depolarization is measured for both polarized and unpolarized incident light, thus characterizing the size and optical anisotropy of the particles or scattering centres. A.

535.436 : 535.325 : 551.593

TABLES OF THE RAYLEIGH SCATTERING COEFFICIENT FOR STANDARD AIR. See Abstr. 2871

535.56 : 538.612

3179. SIMPLE MODEL FOR OPTICAL ACTIVITY. S.Chandrasekhar.
Amer. J. Phys., Vol. 24, No. 7, 503-6 (Oct., 1956).

The paper describes a simple theoretical model for explaining optical activity. The model consists of two anisotropic atoms, each having polarizability α. It is shown that when there is an assembly of such models, the refractive indices for right and left circular light are different, which means that the medium possesses optical rotatory power. By taking α to be complex in the vicinity of an optically active absorption band, the main features of Cotton effect or circular dichroism have also been explained. A.

535.566

3180. OPTICAL ROTATORY DISPERSION OF TRANSITION-METAL COMPLEXES. W.Moffitt.
J. chem. Phys., Vol. 25, No. 6, 1189-98 (Dec., 1956).

The electronic factors governing the rotational strengths of absorption band systems in certain transition-metal complexes are examined. Selection rules are derived which may facilitate the identification of these band systems. A.

535.568.1

3181. A SENSITIVE PHOTOELECTRIC POLARIMETER. B.R.Malcolm and A. Elliott.
J. sci. Instrum., Vol. 34, No. 2, 48-9 (Feb., 1957).

The instrument has a sensitivity considerably higher than the usual visual type but with a more restricted range. Features of the instrument which make for convenience in operation and also to which attention must be paid in order to use fully the intrinsic sensitivity of the system are outlined. A.

535.568.1

3182. PHOTOELECTRIC POLARIMETER USING THE FARADAY EFFECT. E.J.Gillham.
Nature (London), Vol. 178, 1412-13 (Dec. 22, 1956).

A promising design for a photoelectric polarimeter is one in which the plane of polarization of the light leaving the polarizer is made to oscillate through a suitable angle. When the analyser is perpendicular to the mean direction of the plane of polarization, the emergent light intensity may be modulated at twice the frequency of oscillation and has a zero alternating component at the fundamental frequency. This condition may be detected by means of a photocell and amplifier. The desired oscillation of the plane of polarization may be produced by the Faraday effect. Brief details of the latter are given and details of the construction and performance of an experimental instrument described. The results indicate a better performance than that of a visual polarimeter.

H.G.Jerrard

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

535.892

3183. A MERCURY SPECTRUM SOURCE FOR THE GENERAL PHYSICS LABORATORY. S.W.Leifson.
Amer. J. Phys., Vol. 24, No. 7, 528-9 (Oct., 1956).

A convenient source made from a 4 W fluorescent lamp, covered by black tape with a small window left open, and a resistor in place of the usual reactor; the remaining control gear can be obtained commercially. N.Corcoran

HEAT 536

536.2 : 551.513

3184. ON THE THERMAL GRADIENT IN A SATURATED COLUMN OF AIR. P.Glansdorff, C.Rusconi-Muller and P.Caignet.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 6, 721-5 (1956).
In French.

A law governing this phenomenon has been subjected to experimental test in a mine shaft. The observed results are in good agreement with those calculated, the latter being different from those for normal adiabatic (convective) equilibrium. F.E.Hoare

536.2.01

3185. EFFECT OF ISOTOPES ON LOW-TEMPERATURE THERMAL CONDUCTIVITY. G.A.Slack.
Phys. Rev., Vol. 105, No. 3, 829-31 (Feb. 1, 1957).

An analysis of the experimental results of the low-temperature thermal conductivity of single crystals of Si, Ge, and KCl indicates that their maximum conductivities are limited by isotope scattering of phonons rather than by umklapp processes. The isotope scattering in solid helium and sapphire is sufficiently low so that nearly pure umklapp scattering can be observed. The measured thermal conductivities of SiO_2, KBr, and diamond appear to still be limited by impurities. However, even in pure crystals of these three materials the isotope scattering precludes the appearance of pure umklapp scattering. A.

536.2.02

3186. ASYMPTOTIC EXPANSIONS OF SOLUTIONS OF THE HEAT CONDUCTION EQUATION IN INTERNALLY BOUNDED CYLINDRICAL GEOMETRY. R.H.Ritchie and A.Y.Sakakura.
J. appl. Phys., Vol. 27, No. 12, 1453-9 (Dec., 1956).

The formal solutions of problems involving transient heat conduction in infinite internally bounded cylindrical solids may be obtained by the Laplace transform method. Asymptotic series representing the solutions for large values of time are given in terms of functions related to the derivatives of the reciprocal gamma function. The results are applied to the case of the internally bounded infinite cylindrical medium with, (a) the boundary held at constant temperature; (b) with constant heat flow over the boundary; and (c) with the "radiation" boundary condition. A problem in the flow of gas through a porous medium is considered in detail. A.

536.2.08

3187. MEASUREMENTS OF THERMAL CONDUCTIVITY BY A NON-STEADY-STATE METHOD. B.H.Vos.
Appl. sci. Res. A, Vol. 5, No. 6, 425-38 (1955).

The theory of the method is given in detail. In one experimental arrangement a heating wire and a thermocouple are fixed between two pieces of the same specimen so that time–temperature curves can be determined. Methods used to measure the temperature are described and the interpretation of the graphs is considered. The effect of moisture and the influence of temperature on the results are examined. In comparison with the steady-state method the time required for a determination is short (10 min is ample for homogeneous materials); at high temperatures the method is much simpler than the steady-state method. The comparative accuracies are ± 2% for the steady-state and ± 3% for the non-steady-state method.

E.H.Dock

537.311.31 : 538.6 : 536.212.2

ELECTRICAL MAGNETORESISTANCE OF SODIUM. See Abstr. 3188

536.212.2 : 538.6 : 537.311.31

3188. ELECTRICAL AND THERMAL MAGNETO-RESISTANCE IN THIN RODS OF PURE SODIUM. G.K.White and S.B.Woods.
Phil. Mag. (Eighth Ser.), Vol. 1, 846-53 (Sept., 1956).

Measurements are reported on the electrical and thermal resistivity of 130μ and 350μ diameter rods of high purity sodium in transverse magnetic fields (0 to 10 000 oersteds) and at temperatures between 2 and 18°K. These indicate that in the thinner specimen at liquid helium temperature the mean free path is limited by the dimensions of the specimen and that relatively small magnetic fields, of magnitude such that the radius of the electron orbit is comparable with that of the rod, decrease the resistance. At higher fields a linear increase in resistance with field is observed, the relative increase being less at higher temperatures where lattice vibration scattering of the electrons is predominant. A.

536.212.2 : 537.323 : 537.311.31

THERMAL CONDUCTIVITY OF NiTe ALLOYS. See Abstr. 2188

536.212.3 : 548

3189. THERMAL CONDUCTIVITY OF POTASSIUM CHLORIDE CRYSTALS CONTAINING CALCIUM. G.A.Slack.
Phys. Rev., Vol. 105, No. 3, 832-42 (Feb. 1, 1957).

The details of the phonon scattering produced by point imperfections in insulating crystals has been determined from measurements of the thermal conductivity of six single crystals of KCl from 3°K to 30°K as a function of the concentration of point imperfections. These imperfections were produced by the addition of $CaCl_2$, which was incorporated into the KCl crystals as a substitutional impurity during growth from the melt. At temperatures above 15°K the mean free path of the phonons decreases inversely with increasing calcium concentration. The average scattering cross-section of a calcium ion–potassium ion vacancy complex increases as the fourth power of the temperature for low temperatures, and becomes equal to the geometrical cross-section of the vacancy at a temperature of about $\theta_D/6$. Below 15°K the phonon scattering by colloids of precipitated calcium chloride produces a large thermal resistivity in the impure crystals. The thermal conductivity of "pure" KCl at low temperatures is limited mainly by isotope and boundary scattering. The theoretical expressions as given by Klemens for combining thermal resistivities which possess different temperature dependences have been calculated, and have been applied to the present results. The agreement between Klemens' theory and the present experiment as to both the magnitude and the temperature dependence of the thermal resistivity is considered to be satisfactory. A.

536.241

3190. MEASUREMENTS OF THE THERMAL RESISTANCE OF FLAT URANIUM AND ALUMINIUM SURFACES IN CONTACT.
A.Ascoli and E.Germagnoli.
Energia nucleare, Vol. 3, No. 1, 23-31 (Feb. 15, 1956). In Italian.

Some preliminary results of the heat transfer between the surfaces are given. The dependence of the thermal resistivity of the contact upon the coupling pressure and the heat flux has been investigated over a wide range of both parameters, and graphs show the results obtained in air at 10^{-2} mm Hg and at atmospheric pressure. At high coupling pressure (> 150 Kg/cm²) the resistivity is independent of the heat flux. At atmospheric pressure the resistivity is increased to 2 to 3 times that at 10^{-2} mm Hg. The experimental technique and apparatus are described. J.J.Phipps

536.241

3191. CONSIDERATIONS ON THE THERMAL RESISTANCE BETWEEN POLISHED METAL SURFACES IN CONTACT.
A.Ascoli and E.Germagnoli.
Energia nucleare, Vol. 3, No. 2, 113-18 (April 15, 1956). In Italian.

See preceding abstract. Further results are described and discussed. Graphs are given of the dependence of the resistivity on the coupling pressure, up to 250 Kg/cm² for U sprayed with a film of Al in contact with Al, and for stainless steel against Al, with heat fluxes of 13.3 and 15 W/cm² respectively, in air at 10^{-2} mm Hg and at atmospheric pressure. The influence of four grades of polishing of the steel on the thermal resistivity was investigated. The smoother the surface, the lower the resistance. The limiting values of the resistance with the grade of polishing at high coupling pressures are plotted. The values are greater in air, which may be due to pressure effects in the gaseous film trapped between the metal surfaces. J.J.Phipps

536.33 : 535.312 : 535.345

3192. THE DIRECTIONAL DISTRIBUTION AT REFLECTION OF HEAT RADIATION AND ITS INFLUENCE ON HEAT TRANSMISSION. B.Münch.
Dissert. E.T.H. Zürich, No. 2434, 89 pp. (1955). In German.

Describes apparatus for the measurement of reflection and absorption coefficients for infrared radiation at varying angles of incidence. Substances such as pinewood, black oxidized brass, steatite, white paper, silver mirror etc. have been examined at various temperatures of a "black body" furnace-type radiator. Consideration is then given to the problems of: (1) radiation and heat transfer between two surfaces at different temperatures; (2) specular reflection — sphere and plane wall, cylinder parallel to plane wall, eccentric spherical surfaces and eccentric cylindrical surfaces with parallel axes; (3) Lambert's law of reflection is dealt with in reference to the cases mentioned in (2); (4) focusing effects. A.B.Wood

536.42

3193. ON PHASE TRANSFORMATIONS. G.Fischer.
Amer. J. Phys., Vol. 25, No. 2, 100–8 (Feb., 1957).

The aim of the following work is to clarify the definitions of the order of phase transformations, in the case of systems composed of only one substance. First- and second-order phase transformations are discussed with the help of geometrical arguments applied to the intersection of free energy functions. This method also enables us to analyse the behaviour of quantities such as the specific heat. As an application, second-order phase transformations of ferroelectric substances are discussed in some detail. A.

536.42 : 536.7

3194. ON THE SOLUTION OF STEFAN'S REVERSIBILITY PROBLEM FOR A HALF-SPACE WITH A LINEAR LAW OF MOTION OF PHASE BOUNDARIES. G.A.Martynov.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 2, 279-82 (1956). In Russian.

The equations of motion, which may also be regarded as thermal diffusion equations, are set up for the two regions and series solutions obtained. The convergence of the solutions under the given boundary conditions is demonstrated. J.W.Gardner

536.422 : 537.529 : 621.316.923

3195. ELECTRICAL EXPLOSION OF WIRES IN VACUUM.
I.F.Kvartskhava, V.V.Bondarenko, R.D.Meladze and K.V. Suladze.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 737-44 (1956). In Russian.

It is shown that the explosion products move perpendicularly to the wire surface, irrespective of the shape of the latter. At relatively small voltages on the explosion circuit capacitor the distribution of vapour streams possesses, as in the case of an explosion in air, a laminar structure. The layers are arranged perpendicularly to the wire. At high voltages on the capacitor it has been found that the motion of the vapour streams appreciably influences the distribution of the discharge current in the space surrounding the wire. A qualitative explanation of the observed effects is presented. A.

536.422 : 537.529 : 621.317.35 : 621.316.923

3196. OSCILLOGRAPHIC DETERMINATION OF THE ENERGY OF ELECTRIC EXPLOSION OF WIRES. I.F.Kvartskhava, V.V.Bondarenko, A.A.Plyutto and A.A.Chernov.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 745-51 (1956). In Russian.

An oscillographic technique for determination of the energy of electric explosion of wires is described which is free of errors due to inductive distortion of the explosion oscillograms. It is shown that in electric explosions at high voltages the wire resistance is not determined uniquely by the amount of introduced energy. A.

536.422.1

3197. VAPORIZATION COEFFICIENT OF GRAPHITE AND COMPOSITION OF THE EQUILIBRIUM VAPOR. R.J.Thorn and G.H.Winslow.
J. chem. Phys., Vol. 26, No. 1, 186-96 (Jan., 1957).

Direct comparisons of the rates of evaporation and of effusion from a Knudsen cell yield a value of about 0.15 for the vaporization coefficient of graphite. The absolute effusion rates, taken together with other data, not only confirm the existence of triatomic carbon in the equilibrium vapour but permit the evaluation of the thermodynamic properties of the triatomic vapour. In the region of 2400°K the vapour pressure of the triatomic form is $\log p_3(\text{atm}) = -(40296.0/T) + 9.811$ which yields 184.4 kcal/mole for the heat of sublimation and 77.41 eu for the entropy of C_3. This value for the heat agrees with that obtained in mass spectrometric measurements by Chupka and Inghram. The partial pressures at 2400°K of C_1, C_2 and C_3 are 4.29×10^{-8}, 1.13×10^{-8} and 1.05×10^{-7} atm respectively. A comparison with the mass spectrometric data yields 2.7 for the ratio of the ionization cross-section of C_3 to C_1 and values of 0.37, 0.34 and 0.08 for the individual vaporization coefficients of C_1, C_2 and C_3 respectively. The vapour pressure equations used to determine the amount of monatomic and diatomic carbon in the equilibrium vapour are discussed. A.

536.422.15 : 541.64

3198. VAPOR PRESSURE OF PLASTIC MATERIALS. N.Jensen.
J. appl. Phys., Vol. 27, No. 12, 1460-2 (Dec., 1956).

A method is presented of measuring the equivalent nitrogen vapour pressure of polymeric materials over a range of temperatures. It is found that, for the range of temperatures investigated (300-450°K), the vapour pressure–temperature characteristics of the polymeric materials studied are described by the empirical relation $\log P = A - B/T$. The values of the constants A and B in this equation are determined for a number of materials including Nylon, Teflon, Saran, polyethylene and Mylar. A.

536.423.15 : 518.5

3199. AN ELECTRONIC ANALOGUE OF THE SATURATED VAPOUR PRESSURE CURVE OF WATER. R.J.Taylor.
J. sci. Instrum., Vol. 33, No. 11, 436-8 (Nov., 1956).

An analogue of the saturated vapour pressure curve of water between 0 and 30°C which is suitable for inclusion in a complete electrical simulation of the psychrometric equation is described. The stated range of temperature can be covered in three sub-ranges of ten centigrade degrees, each with an accuracy in vapour pressure of a fraction of 1%. A theoretical analysis indicates that the slope of the curve, which is important in certain applications, is reproduced with 2% accuracy. A.

536.44

3200. DEMONSTRATION OF CRITICAL PHENOMENA FOR PURE SUBSTANCES AND MIXTURES. H.H.Reamer and B.H.Sage.
Amer. J. Phys., Vol. 25, No. 2, 58-63 (Feb., 1957).

Appreciation of the physical characteristics of pure substances and mixtures in the vicinity of the critical state is difficult to obtain without direct observation. Demonstration equipment is described that permits the semiquantitative observation of the changes in state encountered during changes in volume of heterogeneous and homogeneous systems along a defined path in the vicinity of the critical state. The apparatus was so arranged that the appearance of the system and semiquantitative values of specific volume, temperature, and pressure may be projected on a screen for observation. A.

536.461

3201. STABILITY AND BURNING VELOCITIES OF LAMINAR CARBON MONOXIDE–AIR FLAMES AT PRESSURES UP TO 93 ATMOSPHERES. R.Edse and W.A.Strauss.
J. chem. Phys., Vol. 25, No. 6, 1241-5 (Dec., 1956).

Bunsen-burner flames of carbon monoxide–air mixtures were investigated at ambient pressures up to 93 atm. The experiments show that the critical velocity gradients at the burner tube wall for flash-back increase with pressure whereas the burning velocities decrease when the pressure is raised. However, in a previous investigation it was found that the burning velocities of hydrogen–oxygen flames increase with pressure. It is concluded that the burning velocities of carbon monoxide–air flames decrease with rising pressure because the rate of diffusion of active particles into the unburned gas is reduced with pressure while no increase in heat transfer occurs. In hydrogen–oxygen flames the rate of heat transfer increases because the flame temperatues are higher at elevated pressures because of the reduction in the degree of dissociation. A.

536.48 : 537.57

3202. IONIC MOBILITIES IN ARGON AND HELIUM LIQUIDS. R.L.Williams.
Canad. J. Phys., Vol. 35, No. 2, 134-46 (Feb., 1957).

The mobilities of ions and electrons have been measured in liquid argon at 90°K, and in liquid helium from 4.2° to 1.4°K. The electron behaviour in liquid argon can be explained in terms of gas-kinetic theory, while the positive ion behaviour in both liquids cannot. Stokes' law predicts the ionic behaviour at the boiling points of the two liquids. Electrons in liquid helium have very small mobilities, approximately one-quarter the value for the positive ions, suggesting a wide departure from the electron behaviour in argon. Below 2.19°K both the electronic and ionic mobilities become temperature and electric field dependent. A.

536.48

3203. SOME PROPERTIES OF LIQUID HELIUM BELOW 1°K. IA-IB. H.C.Kramers.
Proc. K. Ned. Akad. Wetensch. B, Vol. 58, No. 4, 302-12; 313-24 (1955).

By the way of an introduction to the author's experimental investigation the existing theories of liquid helium are reviewed. In particular recent theoretical work on the two-fluid model is discussed in connection with relevant experimental results. R.Eisenschitz

536.48

3204. SOME PROPERTIES OF LIQUID HELIUM BELOW 1°K. IIA-IIB. H.C.Kramers.
Proc. K. Ned. Akad. Wetensch. B, Vol. 58, No. 5, 366-76; 377-85 (1955).

For Pts IA-IB see preceding abstract. Experimental methods for investigating heat pulses and for calorimetry of liquid helium are described. In particular apparatus for magnetic refrigeration, techniques of thermal insulation and magnetic thermometry are considered in great detail. Heat pulses are transmitted and received by carbon or metallic resistors which are connected by amplifiers to an oscilloscope. R.Eisenschitz

536.48

3205. SOME PROPERTIES OF LIQUID HELIUM BELOW 1°K. IIIA-IIIB. H.C.Kramers.
Proc. K. Ned. Akad. Wetensch. B, Vol. 58, No. 5, 386-95; 396-400 (1955).

For Pts IIA-IIB see preceding abstract. As the result of the calorimetric work the specific heat curve of liquid helium is obtained between 0.25 and 2°K. Corrections to the calorimetric measurements are considered carefully. A certain difficulty arises from the fact that the necessary available data are ambiguous; there are two sets of values for the thermal capacity of the paramagnetic salts as used for refrigeration. Corrections are evaluated for both sets of data. It is found that the specific heat curve up to 0.6°K is proportional to T^3 in accordance with the phonon theory. R.Eisenschitz

536.48

3206. SOME PROPERTIES OF LIQUID HELIUM BELOW 1°K. IVA-IVB. H.C.Kramers.
Proc. K. Ned. Akad. Wetensch. B, Vol. 59, No. 1, 35-47; 48-59; Erratum 60 (1956).

For Pts IIIA-IIIB see preceding abstract. The rate of propagation of heat pulses is observed over a wide range of temperatures and in tubes of different dimensions. At temperatures higher than 1°K the pulses travel without any severe distortion and their rate of propagation is independent of the dimensions of the container (normal second sound). At lower temperatures the pulses are distorted and their velocity increases. These effects depend upon the temperature in a complex way and are also influenced by the dimensions of the tube. Broadly speaking the width of the pulses tends to increase during propagation but forward and backward spread are not equal. At the lowest temperatures the velocity of the pulses is comparable with the velocity of first sound. Additional effects arise in the case of large amplitudes of the pulses. The author interprets results as far as possible in terms of the existing theories considering in particular the mean free path of the phonons. R.Eisenschitz

536.48

3207. THE ONSET OF FRICTION IN HELIUM II. D.F.Brewer, D.O.Edwards and K.Mendelssohn.
Phil. Mag. (Eighth. Ser.), Vol. 1, 1130-2 (Dec., 1956).

The thermal resistance of a tube filled with liquid helium [temperature-drop–heat-input] is derived from the two-fluid model.

If there is mutual friction between the normal and the superfluid, the resistance increases with increasing input; alternatively it is independent of the heat input. Experiments are made with a tube of 5×10^{-3} cm diameter, at 1.838°K and a heat input varying between 3 and 23 μwatt It appears that at ~ 12 μwatt there is an almost discontinuous onset of mutual friction between the two fluids. At lower and at higher values of the heat input the appropriate theoretical formulae agree with experiment. Further measurements show that the variation of the heat input may give rise to hysteresis effects. R.Eisenschitz

536.48

3208. FLOW OF HELIUM II IN NARROW SLITS. H.E.Rorschach,Jr.
Phys. Rev., Vol. 105, No. 3, 785-8 (Feb. 1, 1957).

The isothermal flow properties of helium II have been studied at pressure heads between 1 and 16 cm of helium and in slits with an average width between 2 and 5 microns. The results can be partially described in terms of the mutual friction theory of Gorter and Melink. The prediction of the theory that the flow rate should be proportional to the one-third power of the pressure head was verified for the entire pressure range investigated. The agreement is not complete, since the work is consistent only with a mutual friction constant, A, which is a function of temperature and of the slit dimensions. There was no evidence of critical velocity effects in the velocity range investigated (10-30 cm/sec). Interpretation of the experimental work of Allen and Reekie and of Hollis-Hallet indicates that there is a small superfluid friction proportional to the square of the superfluid velocity in addition to the mutual friction. This friction was not observed in the velocity range of the experiments. A.

536.48

3209. ABSORPTION OF SOUND IN LIQUID HELIUM II. W.M.Whitney.
Phys. Rev., Vol. 105, No. 1, 38–41 (Jan. 1, 1957).

The coefficient of absorption of sound in liquid helium has been measured at a frequency of 11.8 Mc/s in the temperature range from 0.2°K to 1°K, at vapour pressure and at 8.0, 13, and 18.3 atm. Careful measurements above 0.9°K at vapour pressure reveal that the two sharp maxima observed by Chase and Herlin at the top of their absorption curve were an instrumental effect. Preliminary results at the higher pressures indicate that, if allowance is made for the pressure variation of the density and the velocity of sound, the attenuation decreases exponentially with pressure at temperatures just below 1°K. A.

536.5.081

3210. THE FREEZING POINTS OF HIGH PURITY METALS AS PRECISION TEMPERATURE STANDARDS. I. PRECISION MEASUREMENTS WITH STANDARD RESISTANCE THERMOMETERS. E.H.McLaren.
Canad. J. Phys., Vol. 35, No. 1, 78–90 (Jan., 1957).

The techniques and difficulties encountered in measuring temperatures to the highest precision with platinum resistance thermometers are discussed. It is shown that the relative drift of the resistance coils in the Mueller resistance bridge used for these measurements is less than a part per million per year. The intrinsic resistance of a platinum thermometer is comparatively unstable, and results showing some effects of cold work and heat treatment on several thermometers are given. As each precision temperature determination involves the resistance of the thermometer at the triple point of water, extensive measurements have been carried out to obtain information on: (a) the reproducibility of temperature in particular cells, (b) the variation in temperature among cells, and (c) the long term stability of cell temperatures. The limiting uncertainties in temperature measurements due to variation in the bridge, the thermometers, and the triple point cells are each of the order of 10^{-4} deg C. A.

536.521

3211. ACCURATE TEMPERATURE MEASUREMENTS IN WORK WITH SOLAR FURNACES. W.M.Conn.
Amer. J. Phys., Vol. 24, No. 8, 581–3 (Nov., 1956).

Furnace considered is in the form of a heliostat mirror of diameter 24–120 in. A specimen is placed at the real image of the sun in the focal plane so that it is heated. If the specimen does not melt its temperature is measured by an optical pyrometer; if it melts it must be contained in a crucible so that the temperature can be measured. Limitations of these systems are briefly considered and the use of a shutter rotating at high speed to shut off sun's radiation from the specimen during measurement improves accuracy. No figures are given. E.H.Dock

536.53 : 539.152.2

3212. PRECISE NUCLEAR RESONANCE THERMOMETER. G.B.Benedek and T.Kushida.
Rev. sci. Instrum., Vol. 28, No. 2, 92-5 (Feb., 1957).

The properties of a thermometer based upon the temperature variation of the pure quadrupole resonance frequency (ν_0) of the Cl^{35} nucleus in granular $KClO_3$ have been investigated. In the range $\sim 10°K < T < 300°K$, the thermometer has a very high sensitivity, being better than ±0.002 deg. at 273°K and ±0.004 deg. at 77°K. The accuracy at 20°K is estimated as at least ±0.02 deg. The thermometer is exactly reproducible if care is taken that the $KClO_3$ is of high chemical purity. No hysteresis effects were observed. Establishment of the thermometer requires a single precise determination of the ν_0 v. temperature curve using the fundamental temperature standards to measure the temperature. A.

536.531 : 536.48

3213. GERMANIUM RESISTANCE THERMOMETERS SUITABLE FOR LOW TEMPERATURE CALORIMETRY. J.E.Kunzler, T.H.Geballe and G.W.Hull.
Rev. sci. Instrum., Vol. 28, No. 2, 96-8 (Feb., 1957).

Single crystal "bridges" of suitably doped germanium have been encased in a strain-free manner within nonmagnetic platinum-glass capsules to provide resistance thermometers with desirable low-temperature electrical properties. The stability of the resistance of these thermometers with repeated cycling between room temperature and liquid helium temperatures and their relatively constant sensitivity (percent change in resistance per percent change in temperature) between 2 and 35°K for a wide range of resistivities are improvements over existing thermometers for this temperature range. Thermometers of this type are believed to be suitable for the most precise measurements, such as calorimetry, and are being further investigated. A.

536.532 : 536.413

3214. MEASUREMENTS OF THE TEMPERATURE IN AN ALUMINIUM-CLAD BAR OF URANIUM. G.Franco and A.Pedretti.
Energia nucleare, Vol. 3, No. 1, 39-45 (Feb. 15, 1956). In Italian.

The bar, 22.7 mm diameter and 270 mm long, with a 1.8 mm aluminium sheath, was Joule-heated by up to 7000 A (500 W/cm length) and cooled by a water flow of up to 150 litres/min in a surrounding annular channel. Readings of thermocouples placed on the bar axis, at 2/3rds of the radius and in the aluminium are given, and also measured thermal dilations of the bar. Maximum temperatures were 230°C on the axis and 54°C in the sheath, with a maximum dilation of 52 microns. R.S.Pease

536.587

3215. TEMPERATURE CYCLE CONTROLLER. J.C.Barnes.
J. sci. Instrum., Vol. 33, No. 12, 494-5 (Dec., 1956).

A description is given of an instrument suitable for use in research laboratories where process time—temperature requirements may be extremely varied and where simplicity of cam layout is therefore of prime importance. A.

536.631 : 548.7

LATTICE VIBRATIONS AND SPECIFIC HEAT OF GRAPHITE. See Abstr. 2797

536.655 : 541.57

3216. HYDROGEN BOND CONTRIBUTION TO THE HEAT OF VAPORIZATION OF ALIPHATIC ALCOHOLS. A.Bondi and D.J.Simkin.
J. chem. Phys., Vol. 25, No. 5, 1073-4 (Nov., 1956).

The hydrogen bond contribution δ(OH) to the heat of vaporization (ΔH_V) of liquid aliphatic alcohols can be estimated from $\delta(OH) = (\Delta H_V - \Delta H_V^*)$. ΔH_V^* is the heat of vaporization of the equistructural hydrocarbon (e.g. C_2H_6 for CH_3OH). This procedure assumes that the dispersion energy contribution of the OH group is equal to that of a methyl group and it leads to an error which is negligible for relatively large molecules but may be significant with small molecules such as CH_3OH. The temperature coefficient of the hydrogen bond strength for n-monohydric alcohols is −10 cal/deg C mole compared with − 6.6 from spectroscopic data. G.Allen

THERMODYNAMICS 536.7/.8

536.7 : 532.77

3217. THERMODYNAMIC THEORY OF IRREVERSIBLE PROCESSES. II. SEDIMENTATION EQUILIBRIUM OF FLUIDS IN GRAVITATIONAL AND CENTRIFUGAL FIELDS. D.G.Miller.

Amer. J. Phys., Vol. 24, No. 8, 555–61 (Nov., 1956).

For Pt I see Abstr. 8154 (1956). Using results of the thermodynamic theory of irreversible processes, general equations are given for the transport of all charged and uncharged constituents of a multicomponent fluid situated in a gravitational or centrifugal field. From these equations, relations describing the special case of sedimentation equilibrium are derived. It is pointed out that the Onsager relations are not required in this case. Different integration paths lead to certain useful exact equations, one of which has been given recently by Young, Kraus, and Johnson. These equations may be used to obtain from sedimentation experiments (1) the activity as a function of the pressures and compositions associated with sedimentation equilibrium; (2) the activity as a function of composition at a given pressure if it is known at one composition and the same pressure and if partial molal volume and density data are known as a function of pressure; (3) the activity as a function of pressure for one composition if it is known as a function of composition at a single pressure, and conversely. A.

536.7 : 541.13

3218. THERMODYNAMIC THEORY OF IRREVERSIBLE PROCESSES. III. THE POTENTIALS OF ELECTROCHEMICAL CELLS IN GRAVITATIONAL AND CENTRIFUGAL FIELDS. D.G.Miller.
Amer. J. Phys., Vol. 24, No. 9, 595–604 (Dec., 1956).

For Pt II see preceding abstract. Using the thermodynamic theory of irreversible processes, a general equation is derived for the solution potential of a multicomponent fluid containing both charged and uncharged species situated in a gravitational or centrifugal field. The argument fully takes into account the irreversible processes of sedimentation and diffusion, and it is shown rigorously how the Hittorf transference numbers of ions and nonelectrolytes enter into the expression. The cell e.m.f. is derived and specialized for three cases of experimental interest; the concentration cell with transference, the homogeneous solution in the field cell, and the sedimentation equilibrium cell. These equations are applied to three common electrode systems with a single binary electrolyte in a single neutral solvent. A.

536.7 : 541.124

3219. ON A RESTRICTIVE CONDITION FOR IRREVERSIBLE CHEMICAL TRANSFORMATIONS. P.Glansdorff.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 5, 628-30 (1956).
In French.

A simple demonstration, when the chemical irreversibility is alone involved, of a general restrictive theorem previously established by Prigogine and the author. F.E.Hoare

536.7

3220. HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF URANIUM DIOXIDE. R.J.Ackermann, P.W.Gilles and R.J.Thorn.
J. chem. Phys., Vol. 25, No. 6, 1089-97 (Dec., 1956).

Effusion measurements have been carried out with uranium dioxide over a temperature range from 1600° to 2800°K and a pressure range from 10^{-5} to 6 mm. Four different isotopic compositions, three different effusion cells and two different apparatuses were used. The results are concordant and demonstrate that the oxide vaporizes congruently in this range. The cubic (fluorite) lattice parameter of the congruently vaporizing composition, $UO_{2.00}$, 5.4588 ± 0.0002kX. All higher oxides will yield $UO_{2.00}$ when heated above 1300°C in a vacuum of 10^{-6} mm Hg. A least-squares analysis of the data yields for the total volatility, calculated as the dioxide, the equation,

$$\log p\,(\text{mm}) = 13.298 - \frac{3.7195 \times 10^4}{T} + \frac{3.5162 \times 10^6}{T^2} + \frac{2.6178 \times 10^9}{T^3},$$

and reveals a pronounced positive curvature at the higher temperatures. It is doubtful that this curvature arises from a deviation of the flow rate from that predicted by kinetic theory, and hence it must be caused by two vaporization processes. The volatility of a uranium and uranium dioxide mixture shows that no gaseous suboxides are important. The principal vapour species at the lower temperatures (1600-2000°K) is undoubtedly UO_2 for which the vapour pressure is given by

$$\log p\,(\text{mm}) = (-33\,115 \pm 371)/T - 4.026\,\log T + 25.686 \pm 0.205.$$

The heat and entropy of sublimation are 137.1 ± 1.7 kcal/mole and 36.4 ± 0.9 eu at 1800°K and 159.6 kcal/mole and 49.4 eu at 298°K. The heat of sublimation at absolute zero is estimated to be 160 kcal/mole with an estimated uncertainty of 5 kcal/mole. This value leads to 14.4 eV for the dissociation energy for gaseous UO_2. The positive curvature cannot be caused by solid monoxide or gaseous UO_3 on the basis of existing thermodynamic data. It is postulated that the curvature is caused by a dimer $U_2O_4(g)$ which beomes important at the high temperatures. Its vapour pressure is represented by

$$\log p\,(\text{mm}) = (-38\,221/T) + 14.056.$$

The heat and entropy of dissociation of the dimer are 88.9 kcal/mole and 16.6 eu at 2450°K. Crude absolute entropy calculations indicate this entropy change to be reasonable. A.

536.71

3221. CRITICAL POINT AND THE BORN–GREEN EQUATION. B.R.Sundheim and E.L.Rubin.
J. chem. Phys., Vol. 25, No. 4, 785-6 (Oct., 1956).

In the Born–Green equation, as solved approximately from the linearized equation by Green, the solution possesses a branch point which has been interpreted as marking the critical point. This note demonstrates a simple method of locating the branch point in Green's solution and shows that it predicts reasonable values for the critical point. It is suggested, by comparison with a solution by Kirkwood et al. of the nonlinear equation, that the linearized equation is a much better approximation than has been recognized heretofore. F.E.Hoare

536.75

3222. PRINCIPLE OF MINIMUM ENTROPY PRODUCTION. H.B.Callen.
Phys. Rev., Vol. 105, No. 2, 360-5 (Jan. 15, 1957).

Prigogine has shown that in the steady state in which certain macroscopic affinities $F_1, F_2, \ldots F_k$ are fixed and other macroscopic affinities $F_{k+1}, F_{k+2}, \ldots F_r$ are unconstrained, the values assumed by the unconstrained affinities are such as to minimize the rate of production of entropy. It is shown here that the complete microscopic density matrix of the system is that which minimizes the rate of entropy production subject to the imposed constraints. All magnetic fields are assumed to be zero. It is shown that the kinetic coefficients connecting Casimer's α-type and β-type variables always vanish. The validity of the minimum entropy production theorem in the absence of a magnetic field depends on this fact. The limitations on the validity of the minimum entropy production theorem in the presence of a magnetic field are briefly discussed. Calculation on particular models by Klein and Meijer and by Klein corroborate the theorem here proved. An analysis of magnetic resonance by Wangsness suggests certain modifications necessary in this case of a nonzero, nonstationary, magnetic field. A.

536.76 : 512.831

3223. MATRIX REPRESENTATION OF THERMODYNAMIC FUNDAMENTALS. J.J.Kyame.
Amer. J. Phys., Vol. 25, No. 2, 67-9 (Feb., 1957).

The use of matrices for representing fundamental thermodynamic relations is demonstrated. Maxwell's relations and other thermodynamic derivatives are readily obtained by differention of the matrices defined. A.

ELECTRICITY 537

537.081 : 538.081

3224. DIMENSIONAL SYMMETRY OF ELECTRICAL AND MAGNETIC QUANTITIES IN THE UNRATIONALIZED MKS SYSTEM OF UNITS. A.J.deBethune and J.J.Perez.
Amer. J. Phys., Vol. 24, No. 8, 584 (Nov., 1956).

537.123

3225. ANTIPROTON–NUCLEON ANNIHILATION PROCESS (ANTIPROTON COLLABORATION EXPERIMENT). W.H.Barkas, R.W.Birge, W.W.Chupp, A.G.Ekspong, G.Goldhaber, S.Goldhaber, H.H.Heckman, D.H.Perkins, J.Sandweiss, E.Segrè, F.M.Smith, D.H.Stork, L.van Rossum, E.Amaldi, G.Baroni, C.Castagnoli, C.Franzinetti and A.Manfredini.
Phys. Rev., Vol. 105, No. 3, 1037-58 (Feb. 1, 1957).

Thirty-five antiproton stars have been found in an emulsion stack exposed to a 700 MeV/c negative particle beam. Of these antiprotons, 21 annihilate in flight and three give large-angle scatters ($\theta > 15^0$, $T_{\bar{p}} > 50$ MeV), while 14 annihilate at rest. From the interactions in flight the total cross-section for antiproton interaction is $\sigma_{\bar{p}}/\sigma_0 = 2.9 \pm 0.7$, where $\sigma_0 = \pi R_0^2$ and $R_0 = 1.2 \times 10^{-13}\ A^{1/3}$ cm. This cross-section was measured at an average antiproton energy of $\overline{T_{\bar{p}}} = 140$ MeV. The antiproton–nucleon annihilation proceeds primarily through pion production with occasional emission of K particles. On the average 5.3 ± 0.4 pions are produced in the primary process; of these, 1 pion is absorbed and 0.3 inelastically scattered. From the small fraction of pions absorbed, it is concluded that the annihilation

occurs mainly at the surface of the nucleus at a distance larger than the conventional radius. A total energy balance of particles emitted in the annihilation gives a ratio of charged to neutral pions consistent with charge independence. Conversely, assuming charge independence, we conclude that the energy going into electromagnetic radiation or neutrinos is small. Comparisons with the Fermi statistical model and the Lepore–Neuman statistical model have been made. Good agreement with the experimental results on the annihilation process can be obtained through appropriate choice of the interaction volume parameters. Several different estimates of the antiproton mass are in good agreement and suggest strongly that the antiproton mass is the same as the proton mass within an accuracy of $2\frac{1}{2}\%$. A study of the elastic scattering of the antiprotons down to angles of 2^0 suggests a possible destructive interference between nuclear and Coulomb scattering. A.

ELECTROSTATICS. DIELECTRICS 537.2

537.21 : 621.317.733

3226. AN ELECTROSTATIC NULL DETECTOR. J.Hart and A.G.Mungall.
J. sci. Instrum., Vol. 33, No. 11, 411–12 (Nov., 1956).

A simple, inexpensive and rugged electrostatic null detector for use in very high resistance bridge circuits is described. The detector has a sensitivity better than 0.5 V and has been used for potential measurements from 0 to 1000 V. It has a capacitance of about 3 pF. A.

537.21

3227. ROTATING PROBE ELECTROMETER. J.C.Devins and S.I.Reynolds.
Rev. sci. Instrum., Vol. 28, No. 1, 11-13 (Jan., 1957).

A new type of scanning electrometer is described which is capable of measuring the charge on areas as small as 0.3 cm^2 at a rate fast enough to show changes in charge distribution on a dielectric surface within intervals of the order of 30 msec. The minimum charge density which can be measured is about 0.6×10^{-9} coulomb cm^{-2}. Resolution of charged areas of the order of one millimetre apart is possible. This provides a new tool for studying the distribution of surface charges in detail. A.

537.213

3228. ON A GENERALIZATION OF POISSON'S PROBLEM. F.Bertolini.
R.C. Accad. Naz. Lincei, Vol. 20, No. 6, 759-66 (June, 1956). In Italian.

A contribution to potential theory. Two theorems of Evans are proved one by a new method. Some generalizations are indicated. L.S.Goddard

537.22 : 621.319

3229. GENERAL PROBLEM OF THE CHARGE ACQUIRED BY A SPHERICAL PARTICLE IN AN ELECTRIC FIELD WITH NEGATIVE AND POSITIVE IONS. M.Pauthenier, R.Cochet and J.Dupuy.
C.R. Acad. Sci. (Paris), Vol. 243, No. 21, 1606-8 (Nov. 19, 1956). In French.

Mathematical derivation of the formulae and investigation of the electrostatic conditions, with generalized assumptions, in a field containing positive and negative ions. A short reference to industrial applications (electric filters and electric precipitation) is made. J.Smuts

537.226 : 536.7

3230. THERMODYNAMIC THEORY OF FERROELECTRIC CERAMICS. H.G.Baerwald.
Phys. Rev., Vol. 105, No. 2, 480–6 (Jan. 15, 1957).

A review of theories of ferroelectricity and of experimental data on ferroelectric ceramics leads to the conclusion that an analytic theory of such ceramics on microscopic basis does not seem feasible. A thermodynamic continuum theory is developed here, which is based on the postulated isomorphism, relevant to small signals only, between a polarized ceramic and one under bias fields near the limit of its nonpolar state; this bears analogy to Mueller's classical theory of rochelle salt. The results of the theory include an elastic relation, which supplements existing experimental data, and a piezoelectric one, which relates to retained polarization and which agrees with measurements. A.

537.226.2

3231. DIELECTRIC BEHAVIOR OF WATER AT MICROWAVE FREQUENCIES. E.H.Grant, T.J.Buchanan and H.F.Cook.
J. chem. Phys., Vol. 26, No. 1, 156-61 (Jan., 1957).

An extensive examination of the dielectric properties has been made. The results have been fitted to various functions which have been derived from the Cole and Cole dispersion equation and it is concluded that the relaxation process in water is characterized by a narrow spectrum of relaxation times. A.

537.226.2 : 532.12

3232. EFFECT OF PRESSURE ON DIELECTRIC PROPERTIES AND VOLUME OF 1-PROPANOL AND GLYCEROL. A.Gilchrist, J.E.Earley and R.H.Cole.
J. chem. Phys., Vol. 26, No. 1, 196-200 (Jan., 1957).

Dielectric constants and loss have been measured to pressures of 1000 kg/cm^2 at audio- and radio-frequencies from 212 to 240^0K for glycerol and 124 to 210^0K for 1-propanol. Compressions to 1000 kg/cm^2 have been measured to room temperature. The increases in static dielectric constant are less than predicted from density increase alone, and the differences are discussed in terms of molecular compression and liquid structure effects. Larger increases of relaxation time with pressure are found at lower temperatures. Constant volume relaxation times do not conform to a simple rate law, and cannot be explained by activation energies depending only on volume. Glycerol shows small, temperature-independent, percentage volume decrease with pressure over the whole range; 1-propanol becomes much less compressible at low temperatures. A.

537.226.2

3233. EFFECT OF PRESSURE ON THE DIELECTRIC CONSTANT OF VITREOUS SILICA. J.Reitzel.
Nature (London), Vol. 178, 940 (Oct. 27, 1956).

The molecular polarizability of silica, proportional to $\{(\epsilon - 1)/(\epsilon + 2)\}$ (1/d)decreases linearly with pressure, at the rate of 1.6×10^{-6} per kg/cm^2. This coefficient is 3 to 10 times lower than for non-polar liquids. K.W.Plessner

537.226.2

3234. TIME LAGS IN THE INTRINSIC ELECTRIC BREAKDOWN OF SOLID DIELECTRICS. R.Cooper and D.T.Grossart.
Proc. Phys. Soc. B., Vol. 69, Pt 12, 1351-3 (Dec., 1956).

When a series of increasing 1 : 5000 μsec impulses are applied to recessed, strain-free ionic crystals (NaCl, KCl, KBr) at 20^0C and -195^0C, distribution of time lags is observed which may be represented by $n = n_0 \exp(-t/T)$, where n = the number breaking down with lags exceeding t μsec, n_0 = the total number tested, and T = a constant $\cong 1$ μsec. With polythene and polystyrene at 20^0C, T $\cong$ 0.25 μsec. J.H.Mason

537.226.2 : 621.315.616.9

3235. ELECTRICAL PROPERTIES AND STRUCTURE OF ORGANO-SILICON POLYMERS. K.A.Andrianov and G.E.Golubkov.
Zh. tekh. Fiz., Vol. 26, No. 8, 1689-95 (1956). In Russian.

Investigations were made of the loss angle and permittivity of: (a) polydimethylsiloxane prepared by the catalytic and thermal condensation methods and (b) polydiethylsiloxane, in the temperature range from -140 to $+200^0$C and at frequencies between 2×10^2 and 1.5×10^6 c/s. Changes in thermal properties of the polymers were investigated in the process of heating and cooling. It is shown that both polymers exhibit relaxation polarization in the region of low temperatures; the introduction of benzoyl peroxide into polydimethylsiloxane prepared by catalytic condensation shifts the relaxation region in the direction of higher temperatures. E.M.Dembinski

537.226.2

3236. ON THE UPPER CURIE POINT OF ROCHELLE SALT. M.S.Kosman and A.N.Shevardin.
Zh. tekh. Fiz., Vol. 26, No. 7, 1443-50 (1956). In Russian.

Polarization of Rochelle salt crystals was investigated in 50 c/s fields over the temperature range 18–40°C. It was found that the ferroelectric properties of the salt do not disappear at 24°C; with stronger fields they continue to exist at higher temperatures. Although the present work is confined only to the upper Curie point there are reasons to believe that the lower Curie point is also, in fact, non-existent. E.M.Dembinski

537.226.2 : 621.315.611

3237. DIELECTRIC STRENGTH OF SEIGNETTE [ROCHELLE] SALT CRYSTALS FOR D.C., A.C. (50 c/s) AND IMPULSE VOLTAGES OF 10^{-4} TO 10^{-7} SEC DURATION. K.M.Kevroleva.
Zh. tekh. Fiz., Vol. 26, No. 10, 2243-7 (1956). In Russian.

Impulse and d.c. strengths of Seignette [Rochelle] salt crystals decrease with increasing thickness of specimen. In the tempera-

ture range +50 to −60°C there is no temperature-dependence of the dielectric strength, nor does the latter depend (for d.c. and impulse voltages) on crystallographic directions. Dielectric strength increases with decreasing pulse duration. In a homogeneous field applied by 1 μsec pulses the dielectric strength of the salt is as high as 1300 kV/cm. Electrical Research Association

537.226.2

3238. DISCONTINUOUS FIELD-INDUCED TRANSITIONS IN BARIUM TITANATE ABOVE THE CURIE POINT. M.E.Drougard.
J. appl. Phys., Vol. 27, No. 12, 1559-60 (Dec., 1956).

New oscillographic measurements of the transition to the polarized state have been made, using crystals with the electrodes extending to the edge. This avoids strains which arise between adjacent parts of a crystal if a margin is left around the electrodes. The transitions are now very much sharper, occurring within 1 μsec. The coercive fields observed agree with theoretical values to within 50%. K.W.Plessner

537.226.2

3239. EFFECT OF PRESSURE ON THE CURIE TEMPERATURE OF POLYCRYSTALLINE CERAMIC BARIUM TITANATE. H.Jaffe, D.Berlincourt and J.M.McKee.
Phys. Rev., Vol. 105, No. 1, 57-8 (Jan. 1, 1957).

The Curie point of polycrystalline barium titanate is found to increase proportionally to the square of an applied planar (two-dimensionally isotropic) compressive stress. A.

537.226.2

3240. CONTRIBUTION TO THE THEORY OF PHASE PHENOMENA IN BARIUM TITANATE. L.P.Kholodenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1034-45 (1956). In Russian.

An explanation is given of the "temperature hysteresis" which accompanies phase transitions. The temperature dependence of the dielectric constant near phase-transition points has been found. Coefficients involved in the thermodynamical theory have been expressed in terms of quantities which can easily be measured. The relaxation time has been estimated. A.

537.226.31 : 621.315.612.2

3241. DEPENDENCE OF DIELECTRIC LOSSES IN CERAMIC MATERIALS ON ELECTRIC FIELD INTENSITY. I.E.Balygin and A.I.Obraztsov.
Zh. tekh. Fiz., Vol. 26, No. 9, 1917-23 (1956). In Russian.

Variation of tanδ with a.c. stress for substances: "ultra-porcelain", porcelain, steatite and other ceramic materials for radio-frequency use, was investigated at temperatures from 26°C to about 300°C. Dielectric losses in these ceramics change very little or not at all with increasing field intensity. In substances which show some slight variation of tanδ with E, this is only observed at relatively low temperatures. Empirical formulae are given for dependences $\tan\delta = f(E)$. Z.Krasucki

537.226.31 : 621.315.616.9

3242. RELAXATION DIELECTRIC LOSSES IN POLYMETHYLMETHACRYLATE. G.P.Mikhaĭlov, T.I.Borisova and D.A.Dmitrochenko.
Zh. tekh. Fiz., Vol. 26, No. 9, 1924-8 (1956). In Russian.

Investigations of temperature dependence of tanδ and capacitance of samples of plasticized and non-plasticized polymethylmethacrylate were made in the frequency range 12 c/s to 80 c/s between the temperatures of 17°C and 120°C. It is shown, that the low-temperature region of $\tan\delta_{max}$ is displaced to lower temperatures when frequency is increased from 12.5 c/s to 75 c/s; it is not affected by additions of plasticizer. The high-temperature region of $\tan\delta_{max}$ is not affected by changes in frequency, but the effect of plasticizer is to move it to lower temperatures. It is concluded that dielectric losses in polymethylmethacrylate are associated, at high temperature, with the movement of the main polymer chain, and at low temperature, with orientational movement of polar groups. Z.Krasucki

537.226.33 : 530.162

3243. QUANTUM THEORY OF DIELECTRIC RELAXATION. E.P.Gross and J.L.Lebowitz.
Phys. Rev., Vol. 104, No. 6, 1528-31 (Dec. 15, 1956).

The statistical behaviour of a system coupled to a reservoir at temperature T is discussed, with the assumption that the interactions are impulsive. Kinetic equations are written for the classical distribution function and quantum density operator. The class of operators admitted leads to a proper description of the irreversible behaviour of the system, but the construction of the collision operator for a given Hamiltonian of system and reservoir is not treated. Application is made to the quantum theory of dielectric relaxation, with the further assumption that the position coordinates of the system are unchanged by collisions. An explicit solution is found for the behaviour in an external alternating field, of a two dimensional dipole of moment of inertia I, subject to strong collisions with the reservoir. For low collision frequency $1/\tau$, discrete rotational lines of width $1/\tau$ are found, while at high collision frequencies there is a continuous Debye spectrum with relaxation time $\tau^* = (1/\tau)/(I/kT)$. At intermediate collision times, the absorption and dispersion are governed by an interplay of quantum and intertial effects. A.

537.228.1 : 534.232 : 620.179.16 : 621.373.421.13

3244. BARIUM TITANATE AS AN ULTRASONIC OSCILLATOR. J.Kainz.
Elektrotech. u. Maschinenbau (EuM), Vol. 73, No. 17, 407-10 (Sept. 1, 1956). In German.

The piezoelectric properties and constants of polycrystalline $BaTiO_3$ are discussed and compared with those of quartz. An equivalent circuit is given and the arrangement for echo testing of materials is described. W.G.Stripp

537.228.1

3245. DEPENDENCE OF THE RATIO OF PIEZOELECTRIC COEFFICIENTS ON DENSITY AND COMPOSITION OF BARIUM TITANATE CERAMICS. D.Berlincourt and H.H.A.Krueger.
Phys. Rev., Vol. 105, No. 1, 56-7 (Jan. 1, 1957).

The ratio of piezoelectric coefficients $-d_{33}/d_{31}$ was found to decrease from about 2.5 for polarized barium titanate ceramic of high porosity to 2.2 for porosity near zero. The ratio increases up to 2.9 for ceramic with 2% porosity containing 12 wt. % calcium titanate. For single crystal barium titanate the ratio $-d_{33}/d_{31}$ is 2.5, which checks well with X-ray data for the ratio of thermal strain in the c and a directions. The value for ceramics of lowest porosity does not, therefore, approach that for the single crystal. A.

537.228.4

3246. MEASUREMENTS ON THE KERR ELECTRO-OPTICAL EFFECT. M.A.Jeppesen.
Amer. J. Phys., Vol. 24, No. 9, 623-5 (Dec., 1956).

An experiment is described in which an inexpensive, commercially available cell is used. Values of the Kerr constant for nitrobenzene determined by this method are given for the spectral range from 4600 A to 8800 A. A.

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.081.3

3247. RESISTANCE IN ABSOLUTE UNITS BY A COMBINATION OF BRIDGE AND RESONANT CIRCUITS. D.S.Ainslie.
Amer. J. Phys., Vol. 25, No. 1, 1-3 (Jan., 1957).

The value, in absolute units, of a resistance was determined in a three-part experiment. In the first part a mica capacitor was measured in terms of resistance and the a.c. line frequency. In the second part an audio oscillator was calibrated in terms of the line frequency. In the third part a resonant circuit, incorporating the oscillator capacitor and a variable inductor, was tuned by varying the inductor which was then compared with a standard inductor. This gives the resistance in terms of the dimensions of the standard and ratios of resistances and frequencies. A.

537.311.1

3248. TRANSFER PROCESSES IN CONDUCTORS WITH NON-LINEAR EFFECTS. V.P.Shabanskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 657-71 (1956). In Russian.

Relaxation processes in the electron–lattice system are analysed and the equations given previously (Abstr. 4635/1955), which take into account heating of the electron gas in strong electric fields, are refined. The solutions of these equations for various cases are analysed and transfer processes which can be deduced from them are considered. A.

537.311.31 : 539.23

3249. ELECTRICAL RESISTANCES OF THIN METAL FILMS BEFORE AND AFTER ARTIFICIAL AGING BY HEATING. R.B.Belser.
J. appl. Phys., Vol. 28, No. 1, 109-16 (Jan., 1957).

The electrical resistances of thin films of 24 metals, deposited on glass substrates (near room temperature) by evaporation, sputtering, or electroplating, have been measured before and after artificial ageing by heating in vacuo. Reductions in resistance of 25 to

50% as a result of ageing were commonly noted. Evaporated films were reduced from approximately $2\rho_b$ to $1.3\rho_b$ (resistivity of the bulk metal) and sputtered films from $4\text{-}10\rho_b$ to $1.5\text{-}1.8\rho_b$. A preferred ageing temperature, specific to each metal but influenced somewhat by film thickness, was noted. The temperature agreed closely with the temperature of recrystallization of the metal. Thin metal films, as usually deposited, appear to be in a state of strain not associated with the bulk metal as it crystallizes from the melt. The application of heat energy to the film promotes the removal of strains, occluded and adsorbed gas, and the growth of the crystallites of the film. These concurrent actions reduce the electrical resistance of films of 1000 A thickness to a value usually in the range 25-75% above that of the bulk metal. A.

537.311.31 : 538.632

3250. HALL EFFECT AND RESISTANCE OF DILUTE GOLD-CHROMIUM ALLOYS AT LOW TEMPERATURES. W.B.Teutsch and W.F.Love.
Phys. Rev., Vol. 10, No. 2, 487-90 (Jan. 15, 1957).

The temperature dependence of the Hall effect and of the electrical resistance has been investigated in pure gold and in gold containing 0.03 and 0.05 atomic % chromium, principally at temperatures in the liquid helium region. For these compositions the temperature dependence of the resistance is abnormal at low temperatures, exhibiting a resistance minimum. No corresponding anomaly was observed in the Hall effect, but neither was it constant as one might expect in terms of a simple theory. Instead, a monotomic increase of the Hall constant with decrease in temperature was obtained below room temperature. This behaviour is not influenced by the presence of a resistivity minimum to any appreciable extent. The experimental results favour the interpretation of the resistance minimum as a scattering phenomenon. The specimens were in the form of annealed foils, approximately 20 x 10 x 0.04 mm. A special circuit permitted measurement of the Hall voltages to 0.01 μV, or about 1 part in 1000. A.

537.311.31

3251. PECULIARITIES OF THE TEMPERATURE DEPENDENCE OF THE ELECTRICAL RESISTANCE OF FERROMAGNETIC METALS AT LOW TEMPERATURES. A.I.Sudovtsov and E.E.Semenenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 525-6 (1956). In Russian.

It may be expected that ferromagnetic metals will show peculiarities in their low-temperature dependence of the electrical resistance due to collisions of the conduction electrons with the ferromagnetic carriers. The authors have carried out measurements on polycrystalline specimens of Fe, Ni, Pt over the range of temperatures from 4.2 to 1.23°K. Curves of the temperature dependence of the resistance are given as well as formulae to fit the results obtained. The peculiarity of Fe and Ni is that their formulae contain a linear term, a result in agreement with certain conclusions of Turov (Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 19, No. 4, 474, 1955). C.R.S.Manders

537.311.31 : 538.63

3252. GALVANOMAGNETIC PROPERTIES OF GOLD. N.E.Alekseevskiĭ and Yu.P.Gaĭdukov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 947-50 (1956). In Russian.

The temperature dependence of the electrical conductivity of four gold samples of various purity have been investigated over the temperature range 0.05 to 20.4°K. Measurements of the dependence of the conductivity on magnetic field strength has been carried out in the same temperature interval. A.

537.311.32

3253. ELECTRICAL CONDUCTIVITY OF BARIUM OXIDE SINGLE CRYSTALS AS A FUNCTION OF TEMPERATURE AND EXCESS BARIUM DENSITY. R.T.Dolloff.
J. appl. Phys., Vol. 27, No. 12, 1418-26 (Dec., 1956).

Four-electrode conductivity measurements over the temperature range from 500 to 1000°K have been made on clear BaO single crystals coloured blue by excess barium densities between 0.3 and 6×10^{17} per cc. Barium was introduced into the crystals by heating in a barium atmosphere and the excess barium densities were computed by the Smakula formula from the 2.0 eV optical absorption band following the method of Sproull, Bever, and Libowitz. The conductivities of the clear crystals attain values of 10^{-4} mho/cm at 1000°K whereas the blue crystals show a conductivity maximum of about 1 mho/cm at about 900°K. The assumption of an electron mobility of 5 cm^2/volt sec leads to an agreement of the saturation electron density and the excess barium density to within a factor of three. A.

537.311.33

3254. THE STOICHIOMETRY OF INTERMETALLIC SEMICONDUCTORS. R.J.Hodgkinson.
J. Electronics, Vol. 2, No. 2, 201-3 (Sept., 1956).

A previous discussion (Abstr. 8180/1956) of the equilibrium conditions in a binary system is extended to systems when the vapour pressure is large. It is shown, from a consideration of the free energy surfaces as a function of composition and specific volume, that the composition of liquid and solid phases are, in general, different at the max. melting point, and that the max. melting point occurs at a non-stoichiometric composition. F.Ansbacher

537.311.33

3255. LIFETIME MEASUREMENTS OF EXCESS CARRIERS IN SEMICONDUCTORS. N.J.Harrick.
J. appl. Phys., Vol. 27, No. 12, 1439-42 (Dec., 1956).

A technique is described whereby bulk carrier lifetimes in semiconductors can be measured over a wide range of injection level without making any electrical connections to the sample. The excess carriers are created by visible light and their distribution is measured by absorption of infrared radiation. The most important advantage of this technique is that the electric field term can be neglected in the continuity equation which describes the carrier distribution and the diffusion length can thus be determined directly. It appears that this technique may be used even in the presence of trapping. Some measurements are described for germanium where it is found that the carrier lifetime may increase or decrease with injection level. This is consistent with the Hall–Shockley–Read theory of carrier recombination. A.

537.311.33

3256. PHYSICAL MODEL OF A SEMICONDUCTOR. J.G.Barredo.
Naturwissenschaften, Vol. 43, No. 15, 346-7 (1956).

The equation describing the so-called chronosuperconductivity is $I = qFdN/dt = KN^2t^{-1/2}$ where I is the current, t the time, N the number of particles, F the Faraday constant and q the charge of the particle. This note justifies the values of 2 for the exponent of N, and $-\frac{1}{2}$ for the exponent of t, and obtains the value of K as a function of the mass and charge of the carrier. W.Bardsley

537.311.33

3257. IONIZED IMPURITY SCATTERING IN NONDEGENERATE SEMICONDUCTORS. N.Sclar.
Phys. Rev., Vol. 104, No. 6, 1548-58 (Dec. 15, 1956).

The treatment for the scattering by ionized impurities in a semiconductor using the partial wave technique is set up and applied using a square well for the attractive impurity and a square barrier to represent the repulsive impurity. For the case $ka \ll 1$ (where k is the wave number of the charge carriers and a is the range of the impurity potential), analytical solutions are obtained for the mobility, μ, and Hall coefficients applicable to nondegenerate semiconductors at low temperatures with high impurity content. The mean free time for scattering is a function of the parameters ka and $(\pm 2m^*q^2a/\hbar^2D)^{1/2}$, where q is the charge of the carrier and D is the dielectric constant. The treatment for reasonable choices of a yields limiting laws of $\mu \propto T^{-1/2}N_I^{-1/3}$ for repulsive centres, while for attractive centres there are three possible limiting cases: $\mu_1 \propto T^{-1/2}N_I^{-1/3}$, $\mu_1 \propto T^{1/2}N_I^{-1}$ and $\mu_3 \to \infty$. Case 2 refers to a form of resonance scattering and case 3 is the Ramsauer effect in semiconductors. These results are markedly different from previous formulae valid for $ka \gg 1$ which yield $\mu \propto T^{3/2}N_I^{-1}$ for both attractive and repulsive centres. A.

537.311.33

3258. NEUTRAL IMPURITY SCATTERING IN SEMICONDUCTORS. N.Sclar.
Phys., Rev., Vol. 104, No. 6, 1559-61 (Dec. 15, 1956).

The scattering of free charge carriers by neutral impurities in semiconductors has been calculated using the partial wave technique by considering the source of scattering to be an attractive potential caused by a negative-energy state associated with the neutral impurity. This calculation has been compared with that due to Erginsoy and with a calculation in Born approximation where the neutral impurity is represented by a hydrogen atom in the dielectric medium of the semiconductor. The treatment gives a mobility that differs from the Erginsoy treatment by only a few percent but predicts a slight temperature dependence. The calculation in Born approximation gives a result similar to that obtained for ionized impurity scattering calculated to the same approximation. The nature of the energy state giving rise to the scattering in this treatment and the possibility of distinguishing experimentally between the different calculations is discussed. A.

537.311.33

3259. ANISOTROPY OF THE HOT-ELECTRON PROBLEM IN SEMICONDUCTORS WITH SPHEROIDAL ENERGY SURFACES. L.Gold.
Phys. Rev., Vol. 104, No. 6, 1580-4 (Dec. 15, 1956).

Energy gain for electrons in many-valley semiconductors for any orientation of electric field is determined. The anisotropy of the hot electron problem is characterized for conditions appropriate at low temperatures where noncollective behaviour of the spheroidal surfaces prevails; it is expected that germanium and silicon will not generally exhibit pronounced anisotropy. Electrons ought to accelerate most readily in the [110] and [211] directions of the former element and in the [100] and [110] of the latter. Anisotropy of the collision time in germanium is shown not to affect the optimal energy gain directions in the limit of $K' \to \infty$ (K' = ratio of longitudinal to transverse collision frequencies), but $K' \to 0$ might produce a shift. The possible observation of the individual drift of injected electron pulses in the Haynes–Shockley experiment is discussed. A.

537.311.33

3260. SPONTANEOUS RADIATIVE RECOMBINATION IN SEMICONDUCTORS. W.P.Dumke.
Phys. Rev., Vol. 105, No. 1, 139–44 (Jan. 1, 1957).

The mechanisms by which electrons and holes recombine with the emission of radiation are examined. Expressions are derived for the radiative recombination lifetimes due to direct and indirect transitions and are applied to Ge and Si. Matrix elements in the transition probability for direct and indirect transitions are obtained from analyses of the cyclotron resonance effective mass data and the optical absorption data close to the band edge respectively. For indirect transitions the calculated lifetimes were of the order of seconds and agreed within a factor of 3 with lifetimes calculated by the method of Van Roosbroeck and Shockley. It is shown that in Ge at room temperature, while the density of filled states in the conduction band at k=0 is very low, the rate of recombination by direct transitions is nevertheless somewhat greater than that by indirect transitions. This is consistent with the findings of Haynes. The role of radiative recombination in the observed lifetimes of excess carriers is questioned. It is concluded that for those semiconductors which have a rather high absorption constant close to the band edge (InSb), an emitted photon is usually reabsorbed before it can escape from the crystal, producing another hole–electron pair, without contributing to the macroscopically observed lifetime. In the limit of a very high absorption constant, this emission and absorption of photons acts as an additional mechanism for the diffusion of hole–electron pairs. A.

537.311.33

3261. ONE-DIMENSIONAL TREATMENT OF THE EFFECTIVE MASS IN SEMICONDUCTORS. I.Adawi.
Phys. Rev., Vol. 105, No. 3, 789-92 (Feb. 1, 1957).

The energy band structure of a one-dimensional crystal is calculated using a Kronig–Penney model. The width of the forbidden band and the effective mass of electrons are determined as a function of the atomic spacing and the asymmetry of the potential. Calculations for a specific average potential show that the effective mass increases monotonically with the potential asymmetry, contrary to a previously published calculation. A.

537.311.33 : 538.61

3262. SPECTRAL DISTRIBUTION OF THE PHOTOMAGNETOELECTRIC EFFECT IN SEMICONDUCTORS: THEORY. W.Gärtner.
Phys. Rev., Vol. 105, No. 3, 823-9 (Feb. 1, 1957).

A solution of the differential equations describing the photomagnetoelectric (PME) effect in semiconductors under small injection of arbitrary spatial distribution is derived for the infinite slab. The results are presented in graphical form showing PME response vs. absorption coefficient with bulk lifetime, surface recombination velocities and slab thickness as parameters. A.

537.311.33

3263. DEFECTS WITH SEVERAL TRAPPING LEVELS IN SEMICONDUCTORS. P.T.Landsberg.
Proc. Phys. Soc. B, Vol. 69, Pt 10, 1056–9 (Oct., 1956).

The statistical problem for the general case of a centre with M levels is solved, giving the Fermi level and the fraction of electrons trapped. Some particular cases are then considered, e.g. a centre having two levels. An analogy is pointed out between the calculation for semiconductor defect centres and gas adsorption isotherms. K.W.Plessner

537.311.33

3264. A METHOD OF EVALUATING SURFACE STATE PARAMETERS FROM CONDUCTANCE MEASUREMENTS ON SEMICONDUCTORS. G.G.E.Low.
Proc. Phys., Soc., B., Vol. 69. Pt 12, 1331–4 (Dec., 1956).

Gives the derivation of the equations used elsewhere (Low, 1956: Report of Rugby Semiconductor Conference) to evaluate the cross-section for capture of majority carriers by surface states, from measurements of the transient change in surface conductance on applying an electrostatic field. R.G.Chambers

537.311.33

3265. THE STATISTICS OF DIVALENT IMPURITY CENTRES IN A SEMICONDUCTOR. C.H.Champness.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1335-9 (Dec., 1956).

Derives expressions for the density ratio n/N of conduction electrons to divalent impurity centres, and gives curves showing n/N against temperature for $10^{14} \leq N \leq 10^{21}$, taking the two activation energies E_a to be 0.01 and 0.2 eV. For such well-separated values of E_a, the results are very similar to those for two independent levels (Landsberg, Abstr. 8185/1952). R.G.Chambers

537.311.33

3266. DRIFT OF MINORITY CARRIERS IN THE PRESENCE OF TRAPPING. A.K.Jonscher.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 223-9 (Feb., 1957).

A simple model of a semiconductor with one trapping level in equilibrium with one band only is defined through the lifetime τ and two trapping time constants τ_C and τ_S. A rectangular pulse of minority carriers is injected at one end and the drift of this pulse in a constant electric field is studied, neglecting diffusion effects. Analytical expressions are derived for the densities of free carriers N and of trapped carriers N_t, as functions of distance and time. Graphs are plotted of the time dependence of N at a collector point, corresponding to drift-decay measurements, and of the spatial distribution of N and N_t at different times, which are relevant in photoconductive measurements. It is concluded that the attenuation of the drifting pulse corresponds to an apparent lifetime which is shorter than the true lifetime τ and that the shape of the (N, time response) curve depends critically not only on the parameters τ, τ_C and τ_S but also on the distance of the collector point from the emitter and on the duration of the injecting pulse. In the case of heavy trapping most of the trapped and free of charge is confined to the immediate neighbourhood of the emitter. In the steady state it is shown that, on this model, the density distribution of free carriers is entirely independent of trapping. A.

537.311.33

3267. DIFFUSION OF MINORITY CARRIERS IN THE PRESENCE OF TRAPPING. A.K.Jonscher.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 230-4 (Feb., 1957).

The steady-state diffusion of minority carriers is studied for the case of continuous injection (d.c.) and sinusoidally variable injection (a.c.) for a simple model of a semiconductor containing one trapping level in equilibrium with one band only. It is shown that the d.c. diffusion is affected only very little by the presence of trapping in extrinsic material. In the extreme case of heavy trapping in near-intrinsic material the effective diffusion length becomes $L^* = \sqrt{2}L$, where L is the diffusion length for the trap-free case. In the case of sinusoidally variable carrier density the effective diffusion length is the same as for the trap-free a.c. case at low frequencies and again at very high frequencies but may become appreciably less at intermediate frequencies. A.

537.311.33

3268. CONTRIBUTION TO THE THEORY OF ATOMIC SEMICONDUCTORS. A.G.Samoĭlovich and V.M.Kondratenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 596-608 (1956). In Russian.

The Vonsovskiĭ polar crystal model is used, taking into account the excitons, in an investigation of some problems of the theory of light absorption and of the theory of photoconductivity in atomic semiconductors. Third-order terms are included in the Hamiltonian. These terms determine the probabilities of different transitions between elementary excitations, which permits study of the kinetics of photoconductivity. A.

537.311.33

3269. THE THEORY OF ISOTHERMAL GALVANO- AND THERMOMAGNETIC PHENOMENA IN SEMICONDUCTORS. F.G.Bass and I.M.Tsidilkovskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 672-83 (1956). In Russian.

Isothermal magnetoresistive and thermomagnetic phenomena in isotropic semiconductors were theoretically studied for the case of intermediate and strong magnetic fields. A.

537.311.33 : 538.63

3270. CONTRIBUTION TO THE THEORY OF GALVANOMAGNETIC PHENOMENA IN SEMICONDUCTORS. M.I.Klinger.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1055-61 (1956). In Russian.

A method is described which was developed for investigation of galvanomagnetic phenomena in crossed electric and magnetic fields taking account of quantization of the current-carrier energy spectrum due to applied fields. The method is applied to semiconductors in which the electron is weakly coupled to the optical and acoustical phonons and the electron gas is not degenerate. A.

537.311.33

3271. PROPERTIES OF GALLIUM INDIUM ANTIMONIDE. J.S.Blakemore.
Canad. J. Phys., Vol. 35, No. 1, 91-7 (Jan., 1957).

Electrical conductivity and Hall effect were measured for p-type specimens of polycrystalline GaSb.InSb with impurity concentration about 10^{17} cm^{-3}. Analysis of these data suggests that $\mu_n/\mu_p = 11$, and that the intrinsic gap varies linearly with temperature from 0.265 eV at 0°K. Measurement of the photoconductive limit at various temperatures shows that the gap widens on heating, though the electrical data seem difficult to reconcile with the large gradient of $+1.1 \times 10^{-3}$ eV/deg C indicated by the optical data. A.

537.311.33

3272. EFFECT OF ANNEALING IN VARIOUS GASES ON THE BULK LIFETIME OF GERMANIUM. K.Weiser.
J. appl. Phys., Vol. 28, No. 2, 271-2 (Feb., 1957).

High-resistivity germanium single crystals were annealed at 500°C in various gases. For an oxygen atmosphere with a trace of water vapour present, the bulk lifetime more than doubled, then decreased to below the initial value. For dry oxygen and for nitrogen, helium, hydrogen, or argon in the presence of water vapour, the lifetime first remained constant, and then decreased. Prolonged annealing in dry helium did not affect the lifetime. The data have been interpreted in terms of a "leaching out" of an impurity recombination centre by a water catalyzed surface oxidation, and a simultaneous formation of an oxide of germanium which diffuses into the bulk and on precipitation acts as a recombination centre. A.

537.311.33

3273. TRIPLE ACCEPTORS IN GERMANIUM. H.H.Woodbury and W.W.Tyler.
Phys. Rev., Vol. 105, No. 1, 84-92 (Jan. 1, 1957).

Both copper and gold introduce three acceptor levels in the forbidden band of germanium. In addition to the levels at 0.04 eV and 0.32 eV from the valence band, Cu introduces a third acceptor level at 0.26 eV from the conduction band. Identification of these levels has been made for a series of samples in which the Cu concentration was varied from 10^{13} cm^{-3} to 2×10^{16} cm^{-3}. Evidence is presented confirming Dunlap's observations that Au introduces a donor level 0.05 eV from the valence band and acceptor levels 0.15 eV from the valence band and 0.20 eV from the conduction band. In addition to these, Au also introduces a third acceptor level 0.04 eV from the conduction band. Studies of charged impurity scattering indicate that both Cu and Au sites may be triply charged by compensation. The observation that impurities with an s^1 configuration are triple acceptors is consistent with the hypothesis that the tendency to form tetrahedral bonds determines the acceptor action of impurities in Ge. A.

537.311.33

3274. FORMATION OF ION PAIRS AND TRIPLETS BETWEEN LITHIUM AND ZINC IN GERMANIUM. F.J.Morin and H.Reiss.
Phys. Rev., Vol. 105, No. 2, 384-9 (Jan. 15, 1957).

As in earlier work on ion pairs involving simpler acceptors, the effects of ion complexes on Hall mobility, and impurity energy levels have been investigated. Relaxation-time experiments have also been performed. The theoretical analysis of the results is in complete accord with the idea that zinc provides two energy levels for electrons in the forbidden gap. A.

537.311.33

3275. ELECTRON SELF-ENERGY AND TEMPERATURE-DEPENDENT EFFECTIVE MASSES IN SEMICONDUCTORS: N-TYPE Ge AND Si. H.D.Vasileff.
Phys. Rev., Vol. 105, No. 2, 441-6 (Jan. 15, 1957).

The electronic self-energy due to interaction with acoustic phonons is evaluated as a function of the electron propagation vector k, and a relation is established connecting the Sommerfeld–Bethe interaction constant with the energy band separation and effective masses. For nondegenerate prolate ellipsoidal energy surfaces of revolution, the self-energy depends linearly on the temperature T at high temperatures and quadratically on T at low temperatures, this behaviour being substantiated by the experimental results of Macfarlane and Roberts. The temperature dependence of the principal effective masses $m_i(T)$ at high temperatures is given by (i = 1 or t)

$$m_i(0)/m_i(T) \doteq 1 + (128\pi/9\rho h^3 s\Theta_D) m_i^2(0) \alpha_i(E) \langle C^2 \rangle_{Av} T$$

thus indicating a decrease in effective mass with rising temperatures. The result does not explain the deviation from the $T^{-3/2}$ law for the lattice mobility as observed by Morin and Maita. The percentage decrease at room temperature for each of the electron effective masses amounts to less than 1%. The results do not account fully for the possible change determined by Lax and Mavroides. A.

537.311.33

3276. EFFECTS OF THICK OXIDES ON GERMANIUM SURFACE PROPERTIES. M.Lasser, C.Wysocki and B.Bernstein.
Phys. Rev., Vol. 105, No. 2, 491-4 (Jan. 15, 1957).

Oxides grown on germanium by heating in oxygen are shown to inhibit interaction between the germanium and the ambient atmosphere. The decay time of the d.c. field effect increases with increasing thickness of the oxide formed. This indicates that the states associated with the oxide lie principally on its outer surface. The decay time decreases, however, in the presence of water vapour, iodine, or ammonia in the ambient. This may be explained as being due to an increase in the density of states on the outer surface of the oxide layer. Desiccation lengthens the decay time greatly. If the oxide layers are of the order of 0.25 μ in thickness, the d.c. field effect displays no measurable decay, and the electrical properties of the underlying germanium are unaffected by a vapour as active as iodine. The surface underneath a thick oxide is shown to be strongly n type and has a low value of surface recombination velocity. A.

537.311.33 : 537.312.9

3277. TEMPERATURE DEPENDENCE OF THE PIEZORESISTANCE OF HIGH-PURITY SILICON AND GERMANIUM. F.J.Morin, T.H.Geballe and C.Herring.
Phys. Rev., Vol. 105, No. 2, 525-39 (Jan. 15, 1957).

The change of resistance in uniaxial compression has been measured for a number of single-crystal specimens of high-resistivity n- and p-type germanium and silicon over the ranges 5° to 350°K (Ge) and 20° to 350°K (Si). For n-type material in the orientations giving the large effect —[110] for n-Ge and [100] for n-Si— the piezoresistance is, as predicted by theory, linear in T^{-1} over the most of the temperature range and with a small intercept. It is rather insensitive to impurity scattering. The departure from linearity in T^{-1} due to the onset of intervalley scattering near room temperature is estimated theoretically; it appears to be just barely detectable for n-Ge. The small piezoresistance of [100]-oriented n-Ge varies little with temperature over most of the extrinsic range, again in accordance with theory. For p-Ge the results suggest that ideally pure material would show a piezoresistance dominated by a T^{-1} term for both [110] and [100] orientations. It is shown that this is to be expected theoretically, although the mechanism of piezoresistance for a degenerate band is more complicated than for a many-valley model. However, the results for p-type material are, as they should be, much more sensitive to impurity scattering, even the sign of the effect varying with the purity for [100] specimens. For p-Si no simple temperature dependence is found, presumably because the spin–orbit splitting of the bands is comparable with kT. At temperatures low enough to condense most of the carriers on to impurity centres, the piezoresistance departs from linearity in T^{-1} and varies from specimen to specimen. This behaviour appears not to be due to impurity scattering; it may be caused in part by inhomogeneities. Surface conduction effects have been observed, but can be eliminated by etching. Neither Hall nor piezoresistance measurements reveal any detectable variation of the ionization energy of donors with strain. No departure of the piezoresistance from linearity in the applied stress has been observed. A.

537.311.33 : 538.63

3278. MAGNETOCONDUCTIVITY IN p-TYPE GERMANIUM. C.Goldberg, E.N.Adams and R.E.Davis.
Phys. Rev., Vol. 105, No. 3, 865-76 (Feb. 1, 1957).

Measurements of the Hall coefficient and resistivity of p-type germanium have been made as a function of magnetic field, temper-

ature, and carrier concentration between 77°K and 300°K. An attempt is made to interpret the data quantitatively using a two-carrier model but no completely satisfactory quantitative interpretation is possible. A.

537.311.33 : 535.345

3279. EFFECT OF IMPURITIES ON FREE-HOLE INFRARED ABSORPTION IN p-TYPE GERMANIUM. R.Newman and W.W.Tyler.
Phys. Rev., Vol. 105, No. 3, 885–6 (Feb. 1, 1957).

The free-hole absorption in p-type germanium (gallium-doped) is studied as a function of concentration over the range from 10^{15} to 10^{20} acceptors/cm^3. The spectra are modified as the carrier and total impurity concentrations are increased. With increasing concentration the structure in the spectrum becomes less pronounced. The effects observed are consistent with changes in the Fermi level and with nonvertical transitions induced by charged impurity centres A.

537.311.33

3280. ELECTRICAL PROPERTIES OF N-TYPE InAs.
T.C.Harman, H.L.Goering and A.C.Beer.
Phys. Rev., Vol. 104, No. 6, 1562–4 (Dec. 15, 1956).

Hall coefficient and resistivity were measured as functions of temperature on uncompensated specimens. A room temperature mobility of 30 000 cm^2/volt-sec was obtained for a donor concentration of 1.7×10^{16} atoms/cm^3. For this impurity density, no indication of a separation of the donor level from the conduction band was observed. A.

537.311.33

3281. EFFECTIVE MASSES OF ELECTRONS IN INDIUM ARSENIDE AND INDIUM ANTIMONIDE. R.J.Sladek.
Phys. Rev., Vol. 105, No. 2, 460-4 (Jan. 15, 1957).

Measurements of the electrical conductivity and Hall effect of n-type indium arsenide and indium antimonide specimens have been made between 1.5°K and 300°K. The dilute metallic character of these substances at low temperatures permits the Fermi level at absolute zero to be obtained from the electrical conductivity v. temperature data. From each Fermi level and the respective conduction electron concentration determined from the Hall effect, the following effective electron masses were obtained: InAs, $m^*/m_0 = 0.020 \pm \pm 0.005$; and InSb, $m^*/m_0 = 0.016 \pm 0.007$. A.

537.311.33

3282. PARAMAGNETIC SPIN–SPIN RELAXATION IN A SEMICONDUCTOR. A.Abragam and J.Combrisson.
C.R. Acad. Sci. (Paris), Vol. 243, No. 7, 650-2 (Aug. 13, 1956). In French.

Gives results of an investigation on As-doped Si in a weak field and discusses the results in terms of the level structure and the transitions between them. E.P.Wohlfarth

537.311.33 : 539.217

3283. DIFFUSION AND ELECTRICAL BEHAVIOR OF ZINC IN SILICON. C.S.Fuller and F.J.Morin.
Phys. Rev., Vol. 105, No. 2, 379–84 (Jan. 15, 1957).

Zinc has been diffused into Si single crystals and estimations of the diffusion constant and solubility have been obtained by conductivity measurements. In the range 1000–1300°C the diffusivity varies between 10^{-6} and 10^{-7} cm^2/sec. However, no definite trend with temperature could be established, presumably because of surface barriers on the Si. A maximum solubility of about 1.4×10^{17} cm^{-3} occurs at 1350°C and retrograde behaviour is observed. Hall effect and conductivity measurements as functions of temperature have been made on Si crystals containing diffused Zn. One acceptor level was found for Zn at 0.31 eV above the valence band. B, Ga, Al, and As were used as doping impurities. The electronic levels of the doping acceptors were altered by the presence of Zn, suggesting compound formation between the acceptor atoms and Zn. A.

537.311.33

3284. MICROPLASMAS IN SILICON. D.J.Rose.
Phys. Rev., Vol. 105, No. 2, 413-18 (Jan. 15, 1957).

At breakdown of reverse-biased silicon junctions one often observes not only discrete current pulses, but also minute luminous spots. It is postulated that these phenomena represent local discharges which are very similar to the gas discharge cathode fall. The mechanism is illustrated for the case of the n–i–p structure. Approximate calculations show that the ionizing regions of these microplasmas are about 500 A in extent, have a current density $\approx 2 \times 10^6$ amp/cm^2, and a net space charge density $\approx 10^{18}$/cm^3. Two such regions are to be associated with each microplasma, except in such narrow junctions that they cannot propertly be separated. The finite duration of the microplasmas, as evidenced by the current pulses, may be explainable on the basis of a statistical fluctuation, in which a fraction of the carriers fail to ionize. If the fluctuation exceeds a critical size, the carrier density rapidly decreases with time, and the microplasma is extinguished. Initiation of the microplasma in linear gradient and step junctions poses a space charge problem that is at present not resolved. A.

537.311.33

3285. HALL AND DRIFT MOBILITY IN HIGH-RESISTIVITY SINGLE-CRYSTAL SILICON. D.C.Cronemeyer.
Phys. Rev., Vol. 105, No. 2, 522–3 (Jan. 15, 1957).

Room-temperature Hall and drift mobilities have been measured for samples of single-crystal silicon ranging in resistivity from about 10^{-3} ohm cm to nearly intrinsic. The Hall mobility figures indicated for lattice scattering are 1560 and 345 cm^2/volt sec for electrons and holes respectively, whereas drift mobility values of 1360 and 510 cm^2/volt sec for electrons and holes, respectively, are found. A.

537.311.33 : 538.63

3286. INVESTIGATION OF THE EFFECT OF PRESSURE ON THE GALVANOMAGNETIC PROPERTIES OF TELLURIUM AT LOW TEMPERATURES. N.E.Alekseevskiĭ, N.B.Brandt and T.I.Kostina.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 943-6 (1956). In Russian.

The galvanomagnetic properties and the influence of uniform compression on them have been investigated in tellurium samples of various purity in the temperature intervals 1.4-4.2, 14-20.4 and 60-78°K and at magnetic fields up to 20 kOe. The existence of a minimum in the electrical resistance v. magnetic field strength curve at helium temperatures has been confirmed. It was found that the magnitude of the minimum is a function of the concentration of impurities and increases on uniform compression. The appearance of a minimum is ascribed to Zeeman splitting of the impurity levels. A.

537.311.33 : 537.312.5

PHOTO- AND SEMICONDUCTION OF AROMATIC HYDROCARBON CRYSTALS. See Abstr. 3300

537.311.33 : 548.7

EFFECT OF QUENCHING ON THE ELECTRICAL RESISTANCE OF PLATINUM. See Abstr. 2821

537.311.33 : 548.7

DEFECTS IN N-TYPE Ge PRODUCED BY ELECTRON BOMBARDMENT. See Abstr. 2824

537.311.33

3287. AMBIPOLAR CARRIER TRANSPORT THROUGH THE BASE REGION OF A JUNCTION TRANSISTOR. W.Gärtner.
J. appl. Phys., Vol. 27, No. 10, 1252 (Oct., 1956).

Early theories of the junction transistor assumed a smaller injection level than is usually employed in practice. It is indicated how the general non-linear small injection equation can be solved and gives an estimate of the corrections to the linear equation employed previously. C.A.Hogarth

537.311.33

3288. NOTE ON THE REDUCTION OF CARRIER LIFETIME IN p–n JUNCTION DIODES BY ELECTRON BOMBARDMENT.
W.Miller, K.Bewig and B.Salzberg.
J. appl. Phys., Vol. 27, No. 12, 1524-7 (Dec., 1956).

Commercial encapsulated silicon p–n junction diodes were bombarded by 2 MeV electrons from a Van de Graaff generator. The reverse transient current and the static current–voltage characteristics of the junction were measured before and after varying intervals of the bombardment time. The time dependence of the reverse transient current is in close agreement with theory, and the reciprocal of the minority carrier lifetime, as inferred from these data, is found to be a linear function of the bombardment time. The bombardment also produced marked changes in the static current–voltage characteristics of the diodes. These data are not in agreement with simple p–n junction theory. A suggested explanation is that the diode behaviour is generally similar to that of a p–i–n junction. A.

537.311.33 : 537.312.5

3289. PROPERTIES OF A CADMIUM SULFIDE PHOTORECTIFIER. D.C.Reynolds, L.C.Greene and L.L.Antes.
J. chem. Phys., Vol. 25, No. 6, 1177-9 (Dec., 1956).

Measurements on a CdS photorectifier show it to have a high resistance in both the forward and reverse directions in the dark. Under illumination considerable conductivity in the forward direction is observed. Light to dark current ratios of 10^6 have been observed. The spectral response of the cell shows two peaks, one at the absorption cut-off the other at 5600 A with the sensitivity tailing off toward the red and infrared. The gain of the cell measured

as a function of radiation intensity can be expressed empirically as a double exponential. The mechanism of the cells is explained on the basis of a model involving the formation of a quasi-intrinsic region by diffusion of the barrier into the crystal. A.

537.311.33

3290. POINT CONTACT OF Pt AND γ-Cu_2S. S.Miyatani.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1059-63 (Oct., 1956).

Point contact between a platinum needle and cuprous sulphide in its γ-phase ($< 105^\circ$C) shows d.c. characteristics similar to those of metal–semiconductor rectifiers. This, however, must be attributed to ionic conduction in the semiconductor. A theoretical consideration shows that the voltage–current characteristics are given by $eV/kT = \log(1 + AI)$ as in the theory of rectification, and that the time of relaxation depends on the effective contact area, s, electronic conductivity, σ_h, and ionic conductivity, σ_i, as $s\sigma_h/\sigma_i$. The experimental results show fairly good agreement with theory. A.

537.311.33

3291. HOLE INJECTION AT METAL–SEMICONDUCTOR POINT CONTACT. D.Gerlich.
Proc. Phys., Soc. B., Vol. 69, Pt 12, 1350–1 (Dec., 1956).

The results of Gunn (Abstr. 9254/1954) are extended to include a point contact with spherical geometry, and a relation between the barrier height and the injection ratio is found. A.E.De Barr

537.311.62 : 537.525

SKIN EFFECT IN GAS DISCHARGES. See Abstr. 3326

537.312.5

3292. ALTERNATING CURRENT MEASUREMENTS ON CADMIUM SULPHIDE CELLS. E.Klier.
Ann. Phys. [Leipzig], Vol. 18, No. 3-4, 163-70 (1956). In German.

An account of measurements of impedance of CdS crystals with ohmic and nonohmic contact electrodes by a bridge method described by Rose (Abstr. 8730/1951). For crystals cleaned by glow discharge treatment, a capacity due to space charge is not established. The measurements show that such crystals exhibit the same behaviour with a.c. as with d.c. M.R.Hopkins

537.312.5

3293. PHOTOCONDUCTIVITY AND SEMICONDUCTIVITY OF ANTHRACENE: EFFECT OF NO_2 AND Cl_2. D.M.J.Compton and T.C.Waddington.
J. chem. Phys., Vol. 25, No. 5, 1075–6 (Nov., 1956).

Treatment of single crystals with NO_2 or chlorine colours the crystal and greatly increases semiconduction. Tee conductivity shows polarization and large reverse currents occur on removal of the field. Increase in longer wavelength response is shown for photoconductivity. G.F.J.Garlick

537.312.5

3294. EFFECT OF HEAT UPON ANTHRACENE PHOTOCONDUCTANCE IN AIR. A.Bree and L.E.Lyons.
J. chem. Phys., Vol. 25, No. 6, 1284–5 (Dec., 1956).

Although photoconductance of anthracene heated in air rises with temperature to a point about 70 or 80°C an irreversible fall-off then occurs even after cooling. This is due to peroxide and to anthraquinone formation. The peroxide first formed increases the photoconductance but anthraquinone inhibits it. G.F.J.Garlick

537.312.5 : 621.383.27

3295. ON THE REDUCTION OF THE DARK CURRENT OF PHOTOMULTIPLIERS. Z.Náray.
J. sci. Instrum., Vol. 33, No. 12, 476–8 (Dec., 1956).

Two methods are used for reducing the rate of dark current pulses of photomultipliers; the reduction is equivalent to a cooling of about 100°C. The two methods are: the reduction of the sensitive area of the photocathode and the application of a suitable shield potential to a layer on the outer surface of the envelope. In the course of the investigation of the shield effect the stability conditions of the multiplier and the effect of the shield potential on the pulse height distribution were studied. A.

537.312.5 : 537.321

3296. THE PHOTO-THERMOELECTRIC PHENOMENON IN SEMICONDUCTORS. L.J.van der Pauw and D.Polder.
J. Electronics, Vol. 2, No. 3, 239-40 (Nov., 1956).

The influence of light on the thermoelectric effect is derived theoretically, but Tauc's derivation (Abstr. 7426/1956) is improved on by including the effect of temperature on the forbidden energy bandwidth. Treatment of the effect using the Peltier heat and the Kelvin relation gives an incorrect result. G.F.J.Garlick

537.312.5 : 535.345

3297. OPTICAL AND ELECTRICAL PROPERTIES OF SILVER CHLORIDE. P.G.Aline.
Phys. Rev., Vol. 105, No. 2, 406–12 (Jan. 15, 1957).

Simultaneous measurements of absorption, fluorescence, and photoconductivity have been investigated for AgCl as functions of exciting radiation and temperature. Excitation in the range of 250 to 400 millimicrons with temperatures from –180°C to room temperature were employed. Frequency-sensitive apparatus was used throughout the measurements with the light beam chopped at 37.5 c/s. An a.c. electrometer circuit was employed to measure currents in the range 10^{-16} to 10^{-11} ampere. The temperature dependence of the absorption edge has been extended to lower temperatures and the coefficient of absorption observed to be an exponential function of wavelength. It was also observed to be an exponential function of $1/T^\circ K$ in the range 387 to 400 millimicrons. The fluorescence of AgCl at –175°C was 482 millimicrons for an exciting wavelength in the region of 270 millimicrons. A second weaker fluorescence peak of undetermined wavelength was observed at temperatures in the neighbourhood of –150°C for an exciting radiation of 390 millimicrons. Photocurrents proportional to the intensity of the exciting radiation were observed in the saturation current region for low applied voltages. Photoconductivity was observed in each of two different regions of the temperature range and wavelength range of exciting radiation employed. There were large photocurrents for wavelengths of exciting radiation less than 270 millimicrons in the temperature region of –175°C and smaller photocurrents at temperatures of –55°C for exciting radiation of 398 millimicrons. The spectral distribution of photoconductivity was also investigated. A.

537.312.5

3298. PHOTOCONDUCTIVITY IN LEAD SELENIDE. EXPERIMENTAL. J.N.Humphrey and W.W.Scanlon.
Phys. Rev., Vol. 105, No. 2, 469-76 (Jan. 15, 1957).

The electrical and photoconductive properties of evaporated films of PbSe have been investigated using oxygen, sulphur, selenium and the halogens as sensitizers. Each sensitizer acts as an acceptor impurity; increasing sensitizer concentration causes the film resistance to increase through a maximum and then decrease, the film changing from n to p type at the resistance maximum. Photoconductivity at room temperature could be produced only by treatment with oxygen; the time constant τ was of the order of 1 μsec. At –195°C photoconductivity (τ = 15 to 30 μsec) could be produced by any of the sensitizers, while oxygen treatment gave in addition a response with $\tau \sim 5$ msec. The spectral response extends to longer wavelengths in thick films than in thin films, but is independent of sensitizer used. It is concluded that oxygen introduces acceptor levels which are minority carrier traps, while the other sensitizers introduce acceptor levels which are not effective minority carrier traps. A.

537.312.5

3299. NOISE, TIME-CONSTANT, AND HALL STUDIES ON LEAD SULFIDE PHOTOCONDUCTIVE FILMS. F.L.Lummis and R.L.Petritz.
Phys. Rev., Vol. 105, No. 2, 501-8 (Jan. 15, 1957).

Measurements of the noise in seven lead sulphide photoconductive films over the frequency range 20-16 000 c/s show that the noise consists mainly of a 1/f component at frequencies below 100 c/s, a generation-recombination component between 100 and 10 000 c/s and a Nyquist component at higher frequencies. The data are analysed to give the magnitude, $N_{S0}(G\text{-}R)$, and the time constant, τ_n, of the generation-recombination noise. The signal time constant, τ_S, is found by measuring the frequency dependence of the photoconductive response. The product of the majority carrier density and the film thickness, pd, is found from measurement of the Hall voltage. Representative values are $N_{S0}(G\text{-}R) = 4.5 \times 10^{-9}$ r.m.s. noise volts/[(d.c. bias volt x $(\Delta f)^{1/2}$], τ_n = 230 μsec, τ_S = 280 microseconds, and pd = 3.0×10^{12}/cm^2. From τ_S and pd, a theoretical value of $N_{S0}(G\text{-}R)$ is calculated and found to be in good agreement with the experimental value. From this and the reasonable agreement between τ_S and τ_n it is concluded that these measurements furnish a verification of the theory of photoconductivity in semiconductor films recently published by one of the authors. Calculation shows that the generation-recombination noise is mainly due to lattice processes; less than 1% is due to radiation fluctuations. It is also shown that noise can be used in place of Hall measurements to evaluate certain semiconductor parameters. A.

537.312.5 : 537.311.33

3300. PHOTO- AND SEMICONDUCTION OF AROMATIC HYDROCARBON CRYSTALS. L.E.Lyons and G.C.Morris.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1162–4 (Nov., 1956).

The spectral dependence of photoconduction in naphthalene, phenanthrene, pyrene, chrysene, diphenyl, and p-terphenyl is investigated. It shows close correlation with electronic absorption spectra and confirms that the photocurrent is greater for more easily oxidized hydrocarbons. G.F.J.Garlick

537.312.6 : 536.53 : 621.316.825 : 621.317.39

3301. A THERMISTOR TEMPERATURE RECORDER. B.M.Zeffert and R.R.Witherspoon.
Analyt. Chem., Vol. 28, No. 11,1701-5 (Nov., 1956).

The present instrument is an adaptation of thermistors to the automatic continuous recording of temperatures in the range -80° to 32° C with an accuracy within 0.05°. The span is divided into 11 ranges of 12° each, with 2° overlap on adjacent ranges. Recording of temperature is linear, making use of the fact that the temperature–resistance variation of a thermistor over relatively small intervals (12°) can be fitted to the same equation that describes the relationship between the resistance of one arm of a Wheatstone bridge and the unbalance bridge voltage. On each range of the instrument the thermistor is part of a Wheatstone bridge circuit, and the unbalance is fed to a potentiometer recorder. A recorder with a high impedance amplifier (to accommodate the 1 MΩ thermistor at -80°) is used. Range selection and range changing are completely automatic. A.

537.312.62

3302. MACROSCOPIC THEORY OF SUPERCONDUCTIVITY VALID AT ALL TEMPERATURES. V.L.Ginzburg.
Dokl. Akad. Nauk SSSR., Vol. 110, No. 3, 358-61 (1956). In Russian.

The problem of expressing the free energy of a superconductor as a function of reduced temperature and "concentration of superconducting electrons" is considered and two particular functions are discussed. The variation of penetration depth with field, the interphase surface energy and the critical field and magnetic moment of a thin film are calculated from the Ginzburg–Landau theory for an arbitrary form of the functional dependence. D.Shoenberg

537.312.62

3303. PHENOMENOLOGICAL EQUATIONS FOR SUPERCONDUCTORS. M.R.Schafroth and J.M.Blatt.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 786-825 (Oct., 1956).

The requirement of a finite correlation length excludes the conventional London equations for superconductors. Alternative equations are proposed and discussed. Some of the consequences are: (1) a magnetic field is not completely expelled from a superconductor; the field at a large depth x is proportional to x^{-1}, rather than dropping off exponentially. (2) The Pippard effect follows as a natural consequence from the equations proposed here. (3) London's correlation between the Meissner field expulsion and persistent currents in superconducting rings depends on an infinite correlation length, and must hence be abandoned; the "persistent" ring currents must be interpreted as relaxation phenomena. The explanation of the enormously long lifetime is not possible within the framework of a purely phenomenological approach, but remains one of the tasks of a future microscopic theory of superconductivity. A.

537.312.62

3304. STRUCTURE OF THE INTERMEDIATE STATE IN SUPERCONDUCTING LEAD. P.B.Alers.
Phys. Rev., Vol. 105, No. 1, 104-8 (Jan. 1, 1957).

The Faraday effect in a cerous nitrate-glycerol mixture has been employed to study the structure of the intermediate state. A lead alloy containing antimony and tin was used as a specimen, and behaviour characteristic of the hard superconductors was observed. Photographs were taken showing the distribution of normal and superconducting material at various magnetic fields. The configurations observed are briefly discussed in terms of current theories of the intermediate state. A.

537.312.62

3305. SIZE EFFECTS IN THE SUPERCONDUCTIVITY OF CADMIUM. R.A.Hein and M.C.Steele.
Phys. Rev., Vol. 105, No. 3, 877-82 (Feb. 1, 1957).

The magnetic threshold field of superconducting cadmium has been investigated as a function of specimen size. With the exception of the bulk material, the specimens were in the form of spheres. In all, five distinct groups were investigated ranging in size from the bulk specimen (irregularly shaped pieces of dimensions of the order of mm) down to spheres 44-62 microns in diameter. A ballistic mutual inductance technique was employed to detect the superconducting transitions. While all the specimens exhibited the same zero-field transition temperature (T_c), a marked increase in the magnetic threshold fields was observed for the three smallest groups. If this increase in the magnetic threshold curves is interpreted in light of existing theories as being due to the specimen size becoming comparable to the penetration depth, values of $(10.4 \pm 0.4) \times 10^{-4}$ cm and $(8.8 \pm 0.3) \times 10^{-4}$ cm are obtained for λ_0, the penetration depth at absolute zero. These two values for λ_0 are based on theoretical expressions presented by von Laue and Silin, respectively. A.

537.312.62

3306. CRITICAL CURRENTS IN SUPERCONDUCTING TIN FILMS. N.E.Alekseevskiĭ and M.N.Mikheeva.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 951-4 (1956). In Russian.

Critical currents in disk-shaped tin film specimens were investigated by a pulse method. The measurements were carried out in a temperature interval $\Delta T = T_k - T \leq 0.5^{\circ}$K and at thicknesses ranging from 6.9×10^{-6} to 6.4×10^{-5} cm. External critical magnetic fields parallel to the film surface were measured for four samples. The critical currents in a temperature range from of 3.7 to 1.6°K were measured in a ring shaped 2×10^{-5} cm thick film by the method of decay of a current induced in the ring. A.

537.322 : 621.56

3307. THERMOELECTRIC REFRIGERATION. L.S.Stil'bans, E.K.Iordanishvili and T.S.Stavitskaya.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 1, 81-8 (1956). In Russian.

The theory of refrigeration using the Peltier effect in semiconductors is summarized and factors influencing choice of materials are discussed. Graphs showing experimental agreement with theory for the case of PbTe are presented. The maximum temperature difference observed was 48°C (from $+34$ to -14°C). This could be improved by the use of two or three couples in cascade, the best figure quoted being 70°C ($+25$ to -45°C) for three cascades. In a practical refrigerator, a 10 litre volume was maintained at 4°C in an ambient of 27°C. J.B.Arthur

537.323

3308. CHANGE OF THE ABSOLUTE THERMOELECTRIC POWER AND ELECTRICAL RESISTIVITY OF COPPER BY COLD-WORKING AT LIQUID AIR AND ROOM TEMPERATURE. M.J.Druyvesteyn and D.J. van Ooijen.
Appl. sci. Res. B, Vol. 5, No. 6, 437-41 (1956).

Experiments with copper wires of diameter 0.025 cm are described. Cold working at liquid air temperature affects the thermoelectric power and resistivity much more than similar treatment at room temperature. Different mechanisms for the effects in the two cases are postulated, resulting from the different diffusion constants of lattice defects at the two temperatures. C.A.Hogarth

537.323

3309. THE THERMOELECTRIC POWER OF COLD-WORKED PLATINUM BETWEEN LIQUID AIR AND ROOM TEMPERATURE. D.J.van Ooijen.
Appl. sci. Res. B, Vol. 5, No. 6, 442-4 (1956).

Measurements of thermoelectric power of cold worked Pt wires 0.03 cm in diameter against undeformed wires are reported. At low temperatures the deformed wires are negative with respect to undeformed wires; the reverse is true at high temperatures. The temperature where the differential thermoelectric power is zero increases for an increasing amount of deformation. The properties of Pt/Pt–Rh and of Pt/deformed Pt couples are compared. C.A.Hogarth

537.324

3310. THERMOELECTRIC GENERATORS. A.F.Ioffe.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 20, No. 1, 76–80 (1956). In Russian.

The theoretical efficiency of a semiconductor thermocouple as a current generator is presented in terms of the resistivities involved and the thermoelectric powers. The relative importances of the thermal conductivity due to the lattice and that due to free electrons are stressed. The factors contributing to maximum efficiency are deduced. J.B.Arthur

537.363 : 578.087.8

3311. AN IMPROVED MICRO-ELECTROPHORESIS ELECTRODE ASSEMBLY FOR USE IN MICRO-BIOLOGICAL INVESTIGATIONS. D.E.E.Loveday and A.M.James.
J. sci. Instrum., Vol. 34, No. 3, 97-8 (March, 1957).

In the assembly described the electrode liquid (potassium chloride solution) is separated from the suspension under investigation by a sintered glass disk (instead of a plaster plug) and this results in a more permanent and reliable apparatus. The apparatus can be used at higher field strengths than was previously possible,

thus enabling low electrophoretic mobility values to be accurately determined. Results obtained are in good agreement with those reported in the literature. A.

ELECTRIC DISCHARGES 537.52

537.521.6

3312. THRESHOLD POTENTIAL FOR THE LOW-FREQUENCY ELECTRIC DISCHARGE IN AIR. D.P.Jatar and H.D.Sharma.
Nature (London), Vol. 178, 1073 (Nov. 10, 1956).

Describes breakdown potential measurements for a pressure range 1-75 mm Hg for cylindrical glass tubes with flat (glass) ends, using a.c. (50 c/s). Pressure x gap length varied up to about 30 mm Hg x cm. J.D.Craggs

537.523.3

3313. GAS DISCHARGES APPLIED TO MEASUREMENT. W.Fucks.
Appl. sci. Res. B, Vol. 5, No. 1-4, 167-75 (1955).

Describes in detail certain characteristics of sphere—sphere corona in air, when a stream of air flows transversely through the discharge gap. Current—pressure data are given. The effect of the direction of the flow is also investigated. Various applications, e.g. to the measurement of the propagation velocity of shock waves, are briefly described. J.D.Craggs

537.523.3

3314. CONTINUED MEASUREMENTS OF IONS FORMED BY CORONA DISCHARGE. H.Norinder and R.Siksna.
Ark. Fys., Vol. 10, Paper 23, 341-53 (1956).

Describes measurements of the mobilities of ions formed in point-corona discharges in air. The ions (positive and negative) were found to have mobilities ranging from about 0.2 to 2.5 cm sec^{-1}/volt cm^{-1}. Data are given for the variation of ion concentrations with wire potential etc., and for the changes in the mobility distributions with corona voltage. J.D.Craggs

537.523.4

3315. THE EXAMINATION OF SPARK DISCHARGES WITH SHORT EXPOSURES. R.F.Saxe.
Appl. sci. Res. B, Vol. 5, No. 1-4, 148-50 (1955).

Describes the principles of operation of and the results obtained with a short-exposure shutter (closing time $< 10^{-9}$ sec) used to study the light output at different stages in the development of a spark in a 1 cm gap at atmospheric pressure. J.Dutton

537.523.4

3316. FORMATIVE TIME LAGS OF SPARK BREAKDOWN. L.H.Fisher.
Appl. sci. Res. B, Vol. 5, No. 1-4, 281-4 (1955).

In air, N_2 and H_2, uniform field breakdown, at up to 2% above threshold, is preceded by Townsend discharges, i.e. photoelectric emission from the cathode by photons created in the gas together with electron avalanches. Delay in breakdown in argon is increased by lag in transmission of radiation through the gap, and in O_2 by formation of negative ions. In positive point—plane corona, formative times are much shorter and vary little with overvoltage. J.H.Mason

537.523.4

3317. RING CONDUCTION IN THE EARLY STAGES OF SPARKS. J.M.Somerville and N.H.Fletcher.
Brit. J. appl. Phys., Vol. 7, No. 11, 419-20 (Nov., 1956).

Shows a photograph of the luminous anode ring observed in spark discharges, together with a study of the mark made on a suitably prepared anode surface. It suggests that, for the first 10-20 μsec, current flow at the anode is confined to a ring. J.D.Craggs

537.523.5

3318. THE BASIS OF A GENERAL THEORY OF THE ANODE FALL. K.H.Höcker.
Appl. sci. Res. B, Vol. 5, No. 1-4, 219-25 (1955). In German.

Relates the anode fall of potential in arcs (or glows) to the ionization processes occurring in the plasma. Field emission and thermal ionization processes are considered. J.D.Craggs

537.523.5 : 537.527.5

3319. PLASMA STREAM PRODUCED BY SELF-MAGNETIC COMPRESSION AND ITS IMPORTANCE FOR THE MECHANISM OF HIGH CURRENT ARCS. H.Maecker.
Appl. sci. Res. B, Vol. 5, No. 1-4, 231-6 (1955).

Describes the effect of the self-magnetic field of a cylindrical plasma in causing a radial pressure increase which, associated with longitudinal variations in column diameter, produces a flow along the discharge axis. Photographs of appropriate discharges are given. Experimental methods, which confirm the general hypothesis, are also given. J.D.Craggs

537.523.5

3320. CURRENT-ZERO PHENOMENA IN HIGH CURRENT A.C. ARCS. D.T.J.ter Horst and G.A.W.Rutgers.
Appl. sci. Res. B, Vol. 5, No. 1-4,248-52 (1955).

Describes briefly the measurement of arc current, voltage, u.v. radiation and arc diameter as a function of time between 20 μsec before to 200 μsec after current zero. Peak currents of 2500 A were used. Typical records are shown. J.D.Craggs

537.525

3321. MEASUREMENT OF PLASMA PARAMETERS BY THE PULSE METHOD IN HIGH-DENSITY DISCHARGE CURRENTS. B.A.Mamȳrin.
Zh. tekh. Fiz., Vol. 23, No. 11, 1915-19 (1953). In Russian.
English translation in: Atomic Energy Res. Establ. (Harwell) Transl. No. 688 (1956).

Consideration is given to the limit of application of the pulse method of probe measurement as the current density of the discharge is increased and the duration of the voltage pulse supplied to the probe reduced. As an example of measurements taken with discharge currents of the order of a hundred amperes, the electron density distribution over the transverse section of a discharge tube is reproduced. A.

537.525

3322. MULTIPLICATION OF ELECTRONS IN THE PRESENCE OF SPACE CHARGES. G.Francis.
Appl. sci. Res. B, Vol. 5, No. 1-4, 53-4 (1955).

The growth of a single initial electron into an avalanche, under the influence of an applied field and the positive-ion space-charge field produced in the avalanche itself, is discussed theoretically. J.Dutton

537.525 : 537.56

3323. DETACHMENT IN ELECTRONEGATIVE DISCHARGES. J.B.Hasted.
Appl. sci. Res. B, Vol. 5, No. 1-4, 63-5 (1955).

Collision experiments, using an apparatus previously described (Abstr. 3577/1951, 3620/1954), are reported for the collisions H^- in H_2, O^- in O_2 and Cl^- in Cl_2. Curves of detachment cross-sections as a function of energy are given, and the relative abundance of negative ions in discharges in these gases discussed. J.Dutton

537.525

3324. POLARITY EFFECTS IN A H.F. DISCHARGE. M.Chenot.
Appl. sci. Res. B, Vol. 5, No. 1-4, 124-6 (1955). In French.

Polarity effects occurring in discharges in H_2 at pressures between 10^{-3} and 2 mm Hg in the range 3.59 to 44.7 Mc/s are examined by measurement of the current—voltage characteristics of the discharge. Electron emission from the internal electrode surfaces due to ion impact appears to play a part in the effects. Changes of the surface state of the electrodes exert a considerable influence on the current. C.G.Morgan

537.525

3325. THEORY OF A H.F. DISCHARGE AT VERY LOW PRESSURES. J.Salmon.
Appl. sci. Res. B, Vol. 5, No. 1-4, 131-4 (1955). In French.

Compares measured values of breakdown potentials in electrodeless discharges at very low pressures with a theoretical expression based on the action of secondary electron emission from the enveloping chamber. Good agreement is obtained. C.G.Morgan

537.525 : 537.311.62

3326. SKIN EFFECT IN GAS DISCHARGES. R.Carruthers.
Appl. sci. Res. B, Vol. 5, No. 1-4, 135-8 (1955).

Voltage-gradient—current measurements made in low-pressure (10^{-3} to 6 x 10^{-2} mm Hg) toroidal discharges in krypton and helium at 100 Mc/s and between 3 and 5 Mc/s gave resistivities of about 0.01 Ω cm for krypton and 0.03 Ω cm for helium. The resistivity was not critically dependent upon the particular gas used or the pressure and appeared to vary in the same way as in solid conductors at high frequencies. Skin effect formulae were thus applicable. C.G.Morgan

537.525 : 539.172

3327. EQUILIBRIUM CHARACTERISTICS OF A PINCHED GAS DISCHARGE COOLED BY BREMSSTRAHLUNG RADIATION. R.S.Pease.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 11-23 (Jan., 1957).

Standard formulae for the electrical resistance and for the radiating properties of a fully ionized gas have been combined with pinch-effect relations to obtain the stationary-state radial-distribution functions and current—voltage characteristics of a radiation-cooled discharge, using a simplified model in which a stationary, axially symmetrical discharge is generated in a long straight tube. The validity of the diffusion conditions implied in the initial equations, the transport properties of the plasma, and the cyclotron radiation arising from thermal motion in the self-magnetic field, are considered. The calculations are applied to the requirements of a power-producing thermonuclear reactor. The chief results are that in a stationary state a pinched discharge will exist with radiation cooling, that the magnitudes of the voltages, tube diameters and initial gas pressure are within reasonable engineering limits, and that a maximum current of one to two million amperes will be encountered. This maximum is a characteristic current of an ionized gas and, slowly varying numerical factors apart, depends directly only on the fundamental constants e, m, $\hbar$ and c. While it is possible to present grounds for supposing these results to be independent of some of the assumptions, the work gives no guidance on the extent to which they will be invalidated by the instability of the current channel. A.

537.525

3328. AN ELEMENTARY THEORY OF THE TRANSIENT PINCHED DISCHARGE. J.E.Allen.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 24-30 (Jan., 1957).

A simple theory of the collapse of a high-current discharge plasma is described. The theory applies to discharges of the type studied by Cousins and Ware (Abstr. 3539/1951), in which shock waves are generated by the self-magnetic "pinch" forces. A.

537.525

3329. OBSERVATIONS OF THE INSTABILITY OF CONSTRICTED GASEOUS DISCHARGES. R.Carruthers and P.A.Davenport.
Proc. Phys. Soc. B., Vol. 70, Pt 1, 49-50 (Jan., 1957).

Observations of gaseous discharges in both straight and toroidal discharge-tubes have shown that a constricted current channel becomes unstable at a particular value of current. Discharges have been studied up to currents of 1500 A and high-speed photographs are reproduced which indicate the helical form of these unstable current channels. A.

537.525 : 530.162

3330. ON THE DEDUCTION OF THE FOKKER—PLANCK EQUATION FOR A PLASMA. S.V.Temko.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1021-6 (1956). In Russian.

The Fokker—Planck equation has been obtained by N.N.Bogolyubov's method for a plasma with several components, and its coefficients have been evaluated explicitly. A.

537.525 : 535.352 : 535.338.4

THE INFLUENCE OF ELECTRON CONCENTRATION ON THE PROBABILITY OF FORBIDDEN TRANSITIONS. See Abstr. 3133

537.525.3

3331. NATURE OF THE ADSORPTION PROCESS RESPONSIBLE FOR JOSHI EFFECT. C.N.Ramachandra Rao.
Canad. J. Chem., Vol. 35, No. 1, 101-3 (Jan., 1957).

A general and brief discussion of the importance of surface effects, due to adsorbed layers etc., in the Joshi effect. The latter is the change in current produced by suitable external illumination of electrodeless a.c. corona discharge tubes. J.D.Craggs

537.527.5

3332. INVESTIGATIONS ON ARC CATHODES. P.Schulz, A.Bauer and P.Gerthsen.
Appl. sci. Res. B, Vol. 5, No. 1-4, 210-18 (1955). In German.

Discusses generally the characteristics of electrode drop regions in discharges, and gives the relevant data, particularly for cathode falls, in xenon and mercury high-pressure arcs. Thermionic and field emission processes at cathodes are discussed. J.D.Craggs

537.525.5

3333. CURRENT LIMITATION IN THE LOW PRESSURE MERCURY ARC. P.C.Thonemann.
Appl. sci. Res. B, Vol. 5, No. 1-4, 237-40 (1955).

Gives a theoretical treatment of current limitation in a low-pressure plasma, without magnetic self-constriction, and provides experimental data which support the theory. J.D.Craggs

537.525.5 : 535.89

3334. XENON ARC TRANSIENTS, ELECTRICAL AND OPTICAL. G.W.LeCompte and H.E.Edgerton.
J. appl. Phys., Vol. 27, No. 12, 1427-30 (Dec., 1956).

The growth of the luminous area of a high current discharge in an electronic xenon-filled flashtube has been studied by means of a sequence of timed short-exposure photographs taken with a magneto-optic shutter. Electrical measurements show that the tube conductance is approximately proportional to the luminous area of the arc channel. The ionized gas has a volume conductivity of about 90 mho/cm averaged over the luminous path during the build-up for the conditions investigated. A.

537.525.5

3335. HIGH POWER DISCHARGES IN AN INTENSE LONGITUDINAL MAGNETIC FIELD. K.S.W.Champion.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 212-22 (Feb., 1957).

The properties of high-power pulsed discharges in hydrogen have been studied. The time for the discharge to reach steady-state conditions was investigated as a function of its parameters. Without a magnetic field the time was of the order of 100 μsec. At high pressures, longitudinal magnetic fields up to 23 000 oersteds caused little change in the time to reach equilibrium, but at low pressures (e.g. 0.46 mm Hg) the time was considerably increased and values up to 2.5 msec were recorded. Observations of the arc diameter showed that a strong uniform magnetic field produced a constriction, unless the natural arc diameter was much greater than the tube diameter. Non-uniform magnetic fields, on the other hand, caused the discharge to become diffuse where the field was diverging. The electrode falls and positive column gradient of the steady-state discharges were measured. Without a magnetic field the electrode falls were 58 V, and the positive column gradient was $60p^{0.34}i^{-0.8}$ where p is the pressure in mm Hg and i the current in amperes. This expression is in reasonable agreement with the theoretical value. The electron densities were found to lie in the range 10^{13} to 10^{15} electrons per cm^3. These densities correspond to ionization of from 0.5% to 12% of the gas atoms. The addition of a magnetic field considerably increased the electrode falls and values as high as 400 V were recorded. At low pressures a magnetic field, as predicted by theory, reduced the positive column gradient. At high pressures, on the other hand, the gradient was increased. For example, with a 100 A arc at 10 mm pressure the gradient was increased from 13 V per cm to 25 V per cm by an intense magnetic field. Again this change is consistent with theory. This change in gradient was accompanied by a 13% increase in the discharge temperature. A.

537.525.5 : 621.3.014.31

3336. THE VOLT—AMPERE CHARACTERISTIC OF AN ELECTRIC ARC COOLED IN A SLOT-TYPE DUCT. G.A.Kukekov.
Zh. tekh. Fiz., Vol. 26, No. 11, 2548-52 (1956). In Russian.

The dynamic VA-characteristic of the arc is obtained by an approximation method on the assumption of linear temperature relation of the electrical conductivity of the plasma and a simplified heat transfer mechanism. The static VA-characteristic is obtained as a particular solution, indicating that the voltage gradient of an arc cooled in a narrow slot does not depend on the current but on the width of the slot. Though the equations derived are approximate, the results agree well with experiment.
Electrical Research Association

537.525.8

3337. A HOLLOW CATHODE GLOW DISCHARGE WITH NEGATIVE RESISTANCE. M.A.Townsend.
Appl. sci. Res. B, Vol. 5, No. 1-4, 75-8 (1955).

Describes some of the characteristics of the hollow-cathode discharge in which a negative resistance is exhibited, in the abnormal glow range. The tube geometry is given. J.D.Craggs

537.525.8 : 537.525.5

3338. CATHODIC GLOW-TO-ARC TRANSITIONS. W.A.Gambling.
Canad. J. Phys., Vol. 34, No. 12B, 1466-70 (Dec., 1956).

One of the main factors determining the onset of a glow-to-arc transition is the electric field at the cathode surface. Because of the physical properties of the cathode dark space this field can only be measured at low pressures and hitherto only crude estimates of its value have been possible at high pressures. This paper develops a method whereby the cathode field strength can be determined at any pressure from a simple measurement of the cathode current density. This has been done for the typical cases of copper electrodes in hydrogen and air. The effect of cathode field strength and other parameters on glow-to-arc transitions is discussed. A.

537.527

3339. ON THE CALCULATION OF THE ELECTRICAL CONDUCTIVITY AND THE THERMAL CONDUCTIVITY OF PLASMAS WITH APPLICATION TO A XENON HIGH-PRESSURE DISCHARGE. H.Schirmer.
Appl. sci. Res. B., Vol. 5, No. 1-4, 196-200 (1955). In German.

Discusses the calculation of the radial temperature distribution in arcs by means of the Elenbaas—Heller differential equation (Physica, Vol. 1, 673, 1934; J. appl. Phys., Vol. 6, 389, 1935) and from observations on light-intensity distribution, giving curves for a particular xenon high-pressure lamp. J.Dutton

537.527

3340. THE BEHAVIOUR OF THE HIGH PRESSURE DISCHARGE IN Xe-Hg MIXTURES. W.Elenbaas.
Appl. sci. Res. B., Vol. 5, No. 1-4, 205-9 (1955).

The experiments described relate to a discharge tube, 3.3 mm internal diameter, filled with Xe at 10 atmospheres, to which a varying percentage (0.2-16%) of Hg has been added. The changes in spectral energy distribution and voltage gradient were observed. The gradient is found to increase very rapidly with the addition of small quantities of Hg. This is shown to be in accord with the results of a simple calculation based on the knowledge of the energy balance in pure Hg and pure Xe discharges. E.A.Ash

X-RAYS 537.531

537.531 : 535.331

3341. X-RAY SPECTRA OF POLONIUM ATOMIC NUMBER 84. W.F.Peed, L.E.Burkhart, R.A.Staniforth and L.G.Fauble.
Phys. Rev., Vol. 105, No. 2, 588-9 (Jan. 15, 1957).

Two samples, each containing an estimated 10 curies (2 mg) of Po^{210}, were purified by vacuum distillation and evaporated onto oblique sections of X-ray targets made of copper. Four lines of the K series and ten lines of the L series of the X-ray spectrum of polonium were recorded with a one-metre transmission crystal spectrograph and a 25 cm Bragg spectrograph, respectively. Measured wavelengths agree approximately with values predicted by extrapolation of Moseley's law and with those reported by Hulubei. Decay of Po^{210} (half-life = 138 days) and growth of Pb^{206} (stable) were observed over a period of 180 days. A.

537.531 : 539.219

SOFT X-RAY EMISSION OF Al-Mg SOLID SOLUTIONS. See Abstr. 2726

537.531.08 : 539.166.08

3342. SPECIAL CdS CELLS HAVE HIGH X- AND GAMMA-RAY SENSITIVITY. L.E.Hollander,Jr.
Nucleonics, Vol. 14, No. 10, 68, 70-1 (Oct., 1956).

Photoconductive CdS crystals with In electrodes of about 0.2 cm^2 area have been developed as small robust detectors. Their conductivity varies linearly with intensity from 0.1 to 10^5 r/hr, changing from 10^{-11} ohm^{-1} cm^{-1} dark to 2 x 10^{-8} ohm^{-1} cm^{-1} in a 100 r/hr 100 keV X-ray beam. The useful energy range exceeds 30 keV to 2 MeV. The disadvantage of a long-rise-time can be reduced by using a steady biasing radiation of 0.05 r/hr. R.D.Smith

537.531.08 : 539.166.08

3343. A COINCIDENCE ARRANGEMENT FOR THE DETECTION OF LOW ENERGY QUANTA. A.Bisi, L.Zappa and E.Germagnoli.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 764-7 (Oct., 1956).

An experimental arrangement, in which a proportional counter and a scintillation γ-ray spectrometer are used in coincidence, is found to be useful in investigations concerning the decay of low-energy γ- or X-ray emitters. Some results which have been obtained with the described method are given. A.

CATHODE RAYS.

POSITIVE RAYS 537.533/.534

537.533 : 537.534

3344. THEORETICAL POSSIBILITY OF SEPARATING BEAMS OF CHARGED PARTICLES WITH DIFFERENT POLARIZATIONS IN A MAGNETIC FIELD. V.V.Vladimirskii.
Dokl. Akad. Nauk. SSSR, Vol. 102, No. 6, 1099-100 (1955). In Russian. English translation in: Atomic Energy Res. Establ. (Harwell) Transl. No. 663, 2 pp. (1956).

It is widely believed that separation of beams of charged particles into components with different spin projections is not possible owing to Bohr's uncertainty principle. The author shows that this conclusion is erroneous: it is possible to produce beams of polarized electrons in magnetic fields. H.Motz

537.533

3345. ELECTRON CYCLOTRON AS A SOURCE OF MEGAVOLT BUNCHED ELECTRON BEAMS. I.Kaufman and P.D.Coleman.
J. appl. Phys., Vol. 27, No. 10, 1250–1 (Oct., 1956).

Electrons accelerated by a microtron are bunched in a phase-stable region which might, typically, extend over 15° of the r.f. cycle, allowing the extraction of energy at frequencies up to about the 25th harmonic of the cavity frequency. A recent analysis has shown that a further phase compression can arise in a particular orbit. The mechanism depends on the variation of radius of the trajectory of electrons, depending on the order of their passage through the time varying cavity field. Calculations on a particular model indicate the possibility of extracting power from the electron bunches at frequencies up to the 500th harmonic of the cavity frequency. E.A.Ash

537.533 : 539.185

3346. ELECTRON ACCELERATOR USED FOR PRODUCING NEUTRONS. A.J.Moses and J.Saldick.
Nucleonics, Vol. 14, No. 9, 118-19 (Sept., 1956).

A 250 μA, 2 MeV Van der Graaff electron accelerator with a gold target was used to produce neutrons by the $Be^9(\gamma,n)Be^8$ reaction. Using a paraffin and beryllium moderator a thermal neutron flux of 10^7 cm^{-2} sec^{-1} over a useful volume of several cm^3 was obtained. R.D.Smith

537.533.1

3347. SINGLE-COMPONENT STATIONARY ELECTRON FLOW UNDER SPACE-CHARGE CONDITIONS. B.Meltzer.
J. Electronics, Vol. 2, No. 2, 118-27 (Sept., 1956).

A general treatment of non-relativistic electron flow in dense beams, from zero-velocity-of-emission cathodes of any shape, in the absence of a magnetic field. Coordinates are used, in which one set of coordinate surfaces coincides with the surfaces of constant action, so that the partial differential equations determining the flow reduce to a single ordinary second-order nonlinear differential equation. As an application, the electrode geometry and current–potential characteristic for space-charge-limited circular flow from a planar cathode, are found. B.Meltzer

537.533.2

3348. EXPERIMENTS FOR STUDYING THE SURFACE OF INSULATORS BY MEANS OF FIELD EMISSION. H.Klumb and K.Neubeck.
Naturwissenschaften, Vol. 43, No. 11, 247 (1956). In German.

An attempt has been made to observe differential emission from a tungsten point coated with an insulator (quartz), after a very thin layer of tungsten had been evaporated on to the quartz. Randomly distributed emission centres were observed at a temperature of about 1000°K. From thicker layers the characteristic emission pattern of isolated single crystals of tungsten was obtained. There was no indication of formation of a continuous coating of metal at the temperatures employed. The use of more easily evaporated metals than tungsten may give useful information on the surface processes which occur in the metalizing of quartz fibres. V.E.Cosslett

537.533.3

3349. A PHOTOGRAPHIC METHOD OF STUDYING THE SPREAD OF TROCHOIDAL ELECTRON BEAMS. N.Strandell.
K. Tekn. Högsk. Handl., Paper 106, 13 pp. (1956).

The trochoidal path and the beam spreading, focusing, etc. of a beam of electrons moving in crossed magnetic and electrostatic fields is studied by photographing the light emitted from residual gas at a pressure of less than 10^{-5} mm Hg. The side and bottom of the box-shaped electrode system are made from glass coated with a transparent conducting silver film. An F2 camera is used. The results show the conditions for optimum beam formation as well as the effects of space charge at high beam currents. M.E.Haine

537.533.33

3350. FOCUSING OF LOW-ENERGY ELECTRON BEAMS. W.W.H.Clarke and L.Jacob.
J. appl. Phys., Vol. 27, No. 12, 1519-24 (Dec., 1956).

Conventional electrostatic and magnetic lenses were used to focus electron beams in the range of energies 30-70 V, produced by a specially designed experimental tube. The electron distribution

in the focused beam was resolved by a series of concentric end collectors and a convention introduced to assess effective beam widths. With near-symmetrical lenses of the electrostatic type and for energies above 30 V, the beam, if inside the aberration limits of the lens, appears to be acted on as a whole by the field and a definite focus is obtained; for 30 V beams, on the other hand, there is no unique focus since maximum and minimum values of effective beam width were recorded as the focus voltage was varied. Such a periodic variation might arise from the existence of standing-wave patterns in the space charge in front of the cathode. A characteristic feature of the focusing which is most marked in the magnetic case is the disappearance on focus of the Gaussian core of the incident beam distribution. With magnetic lenses having apertures in the ratio 2/1, it was remarkable to find that the smaller aperture lens was the most efficient in bringing beams to a focus. In general, the power of magnetic lenses had to be greatly increased (in the measurements, by a factor of 30) over any expected thin lens performance to achieve a focus. Space charge forces, nonhomocentricity, and potential depression are held to be responsible for the abnormal conditions of focus. A.

537.533.331

3351. ELECTROSTATIC LENS. N.P.Carleton.
Rev. sci. Instrum., Vol. 28, No. 1, 9-10 (Jan., 1957).

A possible electrostatic lens consists of a cylindrical surface along which the potential varies as the square of the distance from some original plane. If the cylinder is very long or is terminated without distorting the field within, the trajectories of charged particles inside it can be calculated analytically. These calculations show that a small diameter source of electrons inside the cylinder can be imaged, with magnification unity and slight aberration, at another point in the cylinder. A short section of the cylinder with open ends serves as a thick lens for focusing a beam of particles, the focusing effect being due to the main field inside the cylinder plus end effects. Such a lens was constructed, the boundary condition being realized by a succession of closely spaced rings maintained at the proper potentials. This lens was more efficient in focusing a highly divergent beam of ions than were several combinations of conventional lenses which were also tried. A.

537.533.35 : 539.165.08

3352. HIGHER-ORDER FOCUSING IN THE $\pi\sqrt{2}$ β-SPECTROMETER. G.E.Lee-Whiting and E.A.Taylor.
Canad. J. Phys., Vol. 35, No. 1, 1-15 (Jan., 1957).

The expansion coefficients of that magnetic field which gives best focusing in the high-aperture double-focusing spectrometer have been determined to the sixth order. The analytical calculations have been checked by numerical integration of the equations of the orbits. The third- and fourth-order coefficients published by Stoker et al. (1954) are not in agreement with these results. A.

537.533.35

3353. CONTRAST ARISING FROM ELASTIC AND INELASTIC SCATTERING IN THE ELECTRON MICROSCOPE. M.E.Haine.
J. sci. Instrum., Vol. 34, No. 1, 9-15 (Jan., 1957).

The contrast due to elastic and inelastic scattering of electrons in the electron microscope is calculated on a wave-optical basis. Various approximations are made, especially in the case of inelastic scattering where additional scattering data is required for a rigorous analysis. It is shown that the major contribution to contrast arises from the gap left in the illuminating wavefront by the inelastically scattered electrons. The next most important effect is by phase contrast with elastic scattering. In-phase or amplitude contrast is very small, and the inelastically scattered electrons have little effect except for extended objects. A.

537.533.71

3354. THE REFLECTION OF SLOW ELECTRONS FROM TANTALUM AND COPPER. J.P.Hobson.
Canad. J. Phys., Vol. 34, No. 11, 1089-96 (Nov., 1956).

Targets of tantalum and copper on tantalum have been bombarded by electrons with energy 0-40 eV, and the ratio of the number of back-scattered to incident electrons measured. Particular emphasis has been placed on the range 0-10 eV of primary energy where elastic reflection is dominant. The reflection coefficient for tantalum in this range was found to decrease monotonically as the primary energy fell, approaching a value less than 0.05 as the energy approached zero. This result differs from that of Warnecke below 3.7 eV. The reflection coefficient of copper was found to contain maxima and minima below primary energies of 25 eV in general agreement with the results of Farnsworth. A.

537.533.74

3355. SCATTERING OF CLASSICAL ELECTRONS BY NUCLEI. S.P.Heims, D.G.Ravenhall and D.R.Yennie.
Amer. J. Phys., Vol. 24, No. 8, 568-73 (Nov., 1956).

In connection with recent research at Stanford on the scattering of high-energy electrons by atomic nuclei, a study is made of the scattering of extremely relativistic classical charged particles by a distribution of charge. The approximation is made that the mass of the scattered particle can be neglected; this is valid for the energies used in the experiments (between 100 and 200 MeV). In the case of the point charge there appear orbits in which the particle encircles the nucleus many times before emerging. Cross-sections are obtained for this case, for the spherical shell, and for the "smoothed uniform" charge distribution. From these results it is clear that the experimentally interesting region is completely inaccessible to classical particles, and that the process observed corresponds more to the diffraction of waves. A.

537.533.74 : 539.152.1

3356. SCATTERING OF HIGH ENERGY ELECTRONS AND DISTRIBUTION OF ELECTRIC CHARGE IN NUCLEI. J.Reignier.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 2, 173-84 (1956). In French.

An approximate method is given for the calculation of phase shifts of partial waves. A criterion is given to decide when two charge distributions are equivalent as far as the scattering of one partial wave is concerned. L.Pincherle

537.533.74

3357. MULTIPLE SCATTERING OF 2.4-MeV ELECTRONS IN NUCLEAR EMULSIONS. C.E.Violet.
Phys. Rev., Vol. 104, No. 5, 1454-8 (Dec. 1, 1956).

The multiple scattering of 2.39 ± 0.09 MeV electrons in Ilford G-5 emulsion has been measured for cell lengths of 10, 20 and 40 microns. The independent data of three observers were combined to obtain the best value of the mean scattering angles with and without experimental cutoff. The associated scattering factors for cell lengths between 10 and 40 microns are: $K_{Co} = 24.9 \pm 1.2$ MeV degrees/(100 microns)$^{0.59}$ (for a cutoff at 4 times the mean deviation) and $K_0 = 25.1 \pm 0.8$ MeV degrees/(100 microns)$^{0.58}$. The corresponding values from the Molière theory are 23.5 and 25.7, respectively. A.

537.533.74

3358. ELASTIC SCATTERING OF LOW-ENERGY ELECTRONS BY ATOMIC NITROGEN AND ATOMIC OXYGEN. L.B.Robinson.
Phys., Rev., Vol. 105, No. 3, 922-7 (Feb. 1, 1957).

The phase shifts and elastic scattering cross-sections of atomic nitrogen and oxygen for low-energy electrons have been calculated with central field potentials. Most emphasis has been placed on the Hartree—Fock potentials. In the low-energy range, the WBKJ approximation gives an indefinitly increasing cross-section, whereas the integration of the differential equation yields finite cross-sections in the limit of zero energy, for both nitrogen and oxygen. The Hartree potential does not allow for the existence of a bound state (negative ion) in either case. The Thomas—Fermi potential, although not reliable for low atomic numbers, does allow for the existence of a bound state (of approximately zero energy) in the case of oxygen. A.

537.533.74

3359. ELECTRON POLARIZATION, THEORY AND EXPERIMENT. H.A.Tolhoek.
Rev. mod. Phys., Vol. 28, No. 3, 277-98 (July, 1956).

This is an extensive and detailed review covering polarization of electrons and photons in Coulomb scattering, polarization of electrons and photons in Compton scattering, various methods of producing polarized electrons and polarization of positrons. G.E.Brown

537.533.74 : 539.152.1

ELECTRON SCATTERING AND NUCLEAR STRUCTURE. See Abstr. 2524

537.534.74 : 539.172.13

SCATTERING OF PROTONS FROM C^{12}. See Abstr. 2637

537.533.8

3360. ELECTRON DENSITY AND VELOCITY DISTRIBUTION IN THE OSCILLATORY MULTIPLICATION OF SECONDARY ELECTRONS. K.Krebs and H.Meerbach.
Ann. Phys. (Leipzig), Vol. 18, No. 3-4, 146-62 (1956). In German.

Continuation of previous work (Abstr. 4696/1955). Describes an experimental investigation of the multiplication of secondary electrons and their energy distribution. Applications to the explanation of low-pressure high-frequency discharges are discussed. C.G.Morgan

537.534 : 531.717.8

3361. MAINTAINING THE GEOMETRICAL ALIGNMENT OF A LARGE ACCELERATOR. H.R.Crane.
Amer. J. Phys., Vol. 24, No. 8, 549-54 (Nov., 1956).

In proton accelerators now in the construction or design stages, it appears to be necessary to be able to make adjustments both radially and vertically over distances of several hundred feet with no error greater than 0.02 in. A scheme for accomplishing the required measurements is proposed. A.

537.534

3362. PHASE STABILITY IN CYCLOTRONS WITH THE FIXED FREQUENCY FIELD LAW. L.B.Mullett.
Atomic Energy Res. Establ. (Harwell) Rep. GP/R 2071, 8 pp. (1956).

Two schemes are considered for obtaining phase stability in spiral-ridge cyclotrons without a continuous variation of radio frequency. The first employs a radio-frequency wave travelling outwards from the centre of the machine, and shows some similarity to a linear accelerator, whilst the second has a spatial flutter of magnetic field combined with a periodic time variation of radio-frequency so as to achieve an "alternating gradient" mode of operation. A.

537.534

3363. PRELIMINARY DESIGN PARAMETERS FOR THE 6.5 GeV S/R SYNCHROTRON. W.Walkinshaw.
Atomic Energy Res. Establ. (Harwell) Rep. TP/R 2063, 18 pp. (1956).

Approximate Lagrangian functions are derived for studying particle dynamics in spiral ridged fields. In this way the Hamiltonian features of the dynamics are retained whilst considerable simplification in interpretation is achieved. The application of spiral-ridged focusing to conventional synchrotrons is discussed in some detail. The advantages of the machine are weak radial focusing with consequent low momentum compaction, multiple turn injection and transition energy. The vertical focusing on the other hand is increased with a consequent decrease in vertical aperture. A.

537.534 : 621.384.611

3364. A CYCLOTRON FOR MEDICAL RESEARCH. J.W.Gallop, D.D.Vonberg, R.J.Post, W.B.Powell, J.Sharp and P.J.Waterton.
Proc. Instn Elect. Engrs, Paper 2342M, publ. March, 1957, 12 pp. To be republished in Vol. 104B (1957).

Describes the design and construction of the Medical Research Council fixed-frequency cyclotron. The machine is designed to maintain an output of 200 μA of 15 MeV deuterons in an external beam under routine operating conditions. Special care has been taken throughout the design to ensure ease of maintenance and reliable routine operation. A.

537.534

3365. SOME PROBLEMS IN THE DESIGN AND CONSTRUCTION OF NUCLEAR PHYSICS ACCELERATORS FOR PARTICLE ENERGIES OF A FEW MeV. K.Simonyi.
Nuovo Cimento Suppl. (Ser. 10), Vol. 3, No. 3, 345-62 (1956). In German.

A general discussion of the utility and cost of various high-voltage generators, and a brief description of various machines, including a 4 MeV Van de Graaff generator, installed at the research laboratories of the Hungarian Academy of Science. E.A.Ash

537.534

3366. ENERGY MODULATION FOR PARTICLE ACCELERATORS. L.Cranberg, W.P.Aiello, R.K.Beauchamp, H.J.Lang and J.S.Levin.
Rev. sci. Instrum., Vol. 28, No. 2, 84-8 (Feb., 1957).

The energy of an electrostatic accelerator is modulated over a range of 50 keV by applying an alternating potential of 50 kV amplitude to an insulated target at a frequency of 10 c/s. A sample of the modulating voltage and the signals from a nuclear detector are fed to a so-called "function sampler", which furnishes an output pulse whose height is proportional to the instantaneous value of the target voltage. Analysis of the pulse-height spectrum by means of a 100-channel analyser then affords a presentation of the spectrum of nuclear events as a function of accelerator energy over a 50 keV range, each channel of the analyser corresponding to an energy width of 500 eV. Advantages of this system are discussed for high resolution work with an electrostatic accelerator. A.

537.534

3367. SYNCHROTRON OSCILLATIONS IN STRONG-FOCUSING ACCELERATORS. I. LINEAR THEORY. L.L.Gol'din and D.G.Koshkarev.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 803-14 (1956). In Russian.

Equations for synchrotron oscillations in strong-focusing accelerators are considered. The relation between field strength and frequency was taken into account. A general solution has been obtained which describes the oscillations in the adiabatic as well as in the critical region and corresponding integrals of motion have been obtained. It is shown that motion in the critical region can be simply described with help of an "effective frequency" of the oscillations. The effect of fluctuations of the radiofrequency, accelerating voltage and magnetic field and also the influence of noise on the synchrotron oscillations was considered. Transition through the critical point was also examined. The calculations yield a numerical formula which can be used to determine the tolerances for the various fluctuations. A.

537.534

3368. A METHOD OF ENVELOPES FOR INVESTIGATION OF FREE OSCILLATIONS IN ACCELERATORS. A.M.Baldin, V.V.Mikhaĭlov and M.S.Rabinovich.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 993-1001 (1956). In Russian.

A deduction of the equations for free oscillations in accelerators with an arbitrary magnetic field possessing a symmetry plane is presented. To solve the main problems of free oscillation theory which appear in designing accelerators, an envelope method has been developed in which the study of separate orbits is replaced by a consideration of the envelope of the particle trajectories for a large number of revolutions. The method is illustrated for accelerators with a slit magnet and for strong focusing accelerators. A.

537.534.74 : 539.18

3369. EVALUATION OF THE SCATTERING LENGTHS IN PION–NUCLEON SCATTERING. J.Orear.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 856-9 (Oct., 1956).

All the pion–proton scattering data below 60 MeV which provide values and errors for the phase shifts have been used to obtain the s-wave scattering lengths. The results are $a_1 = 0.167 \pm 0.012$ and $a_3 = -0.105 \pm 0.010$. The value $(a_1 - a_3) = 0.26 \pm 0.04$ as obtained from recent photoproduction results and Panofsky ratio values was also used. The scattering length for α_{33} becomes $a_{33} = 0.22 \pm 0.03$ if one assumes the linear Chew–Low energy dependence up to 170 MeV. A.

537.534.74

3370. ALPHA–ALPHA PARTICLE SCATTERING IN THE ENERGY RANGE 12.3 TO 22.9 MeV. R.Nilson, R.O.Kerman, G.R.Briggs and W.Jentschke.
Phys. Rev., Vol. 104, No. 6, 1673-80 (Dec. 15, 1956).

Absolute differential cross-sections for alpha–alpha particle scattering have been measured at ten energies between 12.3 and 22.9 MeV. The laboratory angular range studied is 11° to 50°. The higher energy experiments at 21.65 to 22.9 MeV were concurrently carried out at two separate scattering chambers, one using nuclear emulsions as the detectors, the other, proportional counters. The experimental accuracy of these experiments is 2% or better at most angles. At the lower energies, 12.3 to 20.4 MeV, the study was made with nuclear emulsion detection only and the experimental accuracy is about 3% at most angles. A.

537.534.74

3371. EXPERIMENTS WITH 315-MeV POLARIZED PROTONS: PROTON–PROTON AND PROTON–NEUTRON SCATTERING. O.Chamberlain, E.Segrè, R.D.Tripp, C.Wiegand and T.Ypsilantis.
Phys. Rev., Vol. 105, No. 1, 288-301 (Jan. 1, 1957).

The polarization in elastic p–p and p–n scattering at 315 MeV has been measured as a function of the scattering angle. The maximum polarization observed in each of these interactions is approximately 40%. A similar measurement of the polarization in p–p scattering at 276 MeV is also reported. Triple-scattering experiments have been performed to measure the depolarization $D(\theta)$ and the rotation $R(\theta)$ in the proton–proton interaction. These parameters have been measured for centre-of-mass scattering angles ranging from 22 to 80°. Expressions for the measured quantities in terms of 14 phase shifts of the proton–proton system for $J \leq 6$ and $l \leq 5$ are included. Two of the phase shifts represent mixing between states of the same total angular momentum J, spin S, and parity. Five sets of phase shits are reported which satisfy 36 measurements of total cross-section, relative differential cross-section, polarization, depolarization, rotation, and supplementary conditions imposed by the analysis of information from the reaction $p + p \rightarrow \pi^+ + d$. A.

537.534.74

3372. PHASE-SHIFT ANALYSIS OF 310-MeV PROTON–PROTON SCATTERING EXPERIMENTS. H.P.Stapp, T.J.Ypsilantis and N.Metropolis.
Phys. Rev., Vol. 105, No. 1, 302-10 (Jan. 1, 1957).

The results of a phase-shift analysis of proton–proton cross-

section, polarization, and triple-scattering experiments at ~310 MeV are reported. From an extensive search five satisfactory solutions have been found. Three additional solutions that give fair fits to the data are also reported. A.

537.534.74 : 539.185

3373. TWO-NUCLEON INTERACTION AT HIGH ENERGIES AND THE LÉVY POTENTIAL. H.Gelernter.
Phys. Rev., Vol. 105, No. 3, 1068–74 (Feb. 1, 1957).

The predictions of the Levy potential for nucleon—nucleon scattering and polarization at high energies have been explored. Most of the computations were made at 162 MeV, although some have also been done at 105 and 348 MeV. Various values of the Blatt—Kalos parameters were tried as well as certain modifications in the coupling constants and the range which surrender approximate agreement with the low-energy data. No satisfactory agreement with the unpolarized and polarized cross-sections could be found. The need of a spin—orbit term in the two-nucleon interaction is discussed. A.

537.534.75

3374. STATISTICAL FLUCTUATIONS IN ENERGY LOSSES OF 37-MeV PROTONS. T.J.Gooding and R.M.Eisberg.
Phys. Rev., Vol. 105, No. 1, 357–60 (Jan. 15, 1957).

The frequency distributions of energy losses of 37 MeV protons has been measured for a wide range of thin absorbers. The purpose of this experiment was to compare the measured distributions with the theory of Landau and Symon. The measurements required the application of both scintillation and proportional counter techniques. A simple method of unfolding the inherent resolution of the scintillation counter was developed. The observed distributions were found to be in good agreement with the Landau—Symon theory. A.

537.534.8

3375. ELECTRON EJECTION FROM METALS BY POSITIVE IONS. H.D.Hagstrum.
Appl. sci. Res. B, Vol. 5, No. 1-4, 16-17 (1955).

Measurements of the total yield and energy distribution of secondary electrons liberated from atomically clean W and Mo surfaces by the singly charged ions of He, Ne, A, Kr and Xe at pressures near 10^{-10} mm Hg. Specific contamination of the clean surfaces profoundly affected the results. It appears that the mechanism of electron liberation is an Auger process when the surfaces are clean but for contaminated surfaces the results cannot be explained solely by the simple Auger process. Electron ejection due to the kinetic energy of the incident ion is in evidence.

C.G.Morgan

537.534.8

3376. SOFT RADIATIONS PRODUCED BY PROTON BOMBARDMENT. J.M.Hansteen.
Arch. Math. Naturvid., Vol. 53, Paper 6, 20 pp. (1956).

The formation of characteristic X-radiation by proton bombardment is investigated theoretically on the basis of the Born approximation. The spectral distribution of the δ-rays produced by protons, and the bremsstrahlung produced by these δ-rays is also investigated. An experiment to test the theory is suggested.

J.Hughes

537.534.8

3377. EMISSION OF ELECTROMAGNETIC RADIATION BY THE IMPACT OF POSITIVE IONS OF HYDROGEN ON METAL SURFACES. R.M.Chaudri, M.Y.Khan and A.L.Taseer.
Phys. Rev., Vol. 104, No. 5, 1492-3 (Dec. 1, 1956).

See Abstr. 7482 (1956). The experimental arrangement there described has been used to determine the radiation immediately after degassing the target and 24 hours later. The clean target produces less radiation. The wavelengths emitted mostly lie between 3300-4000 A. A.H.W.Beck

537.534.8

3378. POLARIZATION OF RELATIVISTIC PROTONS IN COULOMB SCATTERING. M.G.Urin and V.N.Mokhov.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 842-4 (1956). In Russian.

The magnitude of the relative polarization of relativistic protons scattered in a Coulomb field was obtained by perturbation theory calculations. A.

DISCHARGE TUBES. COUNTERS 537.54

537.542

3379. VELOCITY OF DISCHARGE PROPAGATION IN GEIGER-MÜLLER COUNTERS. P.Mortier.
Appl. sci. Res. B, Vol. 5, No. 1-4, 302-4 (1955).

Gives data for 100 cm counter tubes with divided cathodes, filled with hydrogen—ethyl alcohol mixture. Propagation speeds vary from about 2-50 cm/μsec. There is a brief discussion.

J.D.Craggs

537.542 : 578.087.8

DUAL PROPORTIONAL COUNTER FOR LOW-LEVEL MEASUREMENT OF ALPHA ACTIVITY OF BIOLOGICAL MATERIALS. See Abstr. 2878.

537.542

3380. HIGH-PRESSURE Al-WALLED SENSITIVE IONIZATION CHAMBER. P.A.Duffy.
Nucleonics, Vol. 14, No. 9, 132-3 (Sept., 1956).

Details of a small chamber filled with argon at 17 atm. The output is 60 times that of an air-equivalent chamber of the same volume and the γ-response is flat to within 12% from 100 keV to 1 MeV. R.D.Smith

537.542

3381. SCINTILLATION COUNTING.
I.R.E. Trans Nuclear Sci., Vol. NS-3, No. 4, (Nov., 1956).

The above number contains complete versions of the articles abstracted in Abstr. 5796-7, 5969-74, 5976, 5979 (1956).

537.542

3382. DESIGNING SENSITIVE PLASTIC-WELL COUNTERS FOR BETA RAYS. W.S.Michel, G.L.Brownell and J.Mealey, Jr.
Nucleonics, Vol. 14, No. 11, 96-100 (Nov., 1956).

An investigation of the effects of scintillator wall thickness, absorber thickness, discriminator level and sample size on counting rate efficiency. The preparation of suitable samples is described and efficiencies for typical β-emitters listed. R.D.Smith

537.542 : 621.387

3383. A COAXIAL TROCHOTRON. W.Rentsch.
Hochfrequenztech. u. ElektAkust. Vol. 65, No. 2, 68-72 (Sept., 1956). In German.

Describes developments of Swedish work on trochoidal-path counter-tubes for electrons. Field distributions and electron paths are shown for various anode-potential distributions, and detailed characteritics are given in graphs. J.D.Craggs

537.542

3384. A COSMIC-RAY GAS ČERENKOV COUNTER WITH ADJUSTABLE VELOCITY THRESHOLD. R.J.Hanson and D.C.Moore.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1558-64 (Dec., 1956).

Measurements of performance have been made on a gas Cherenkov counter with CO_2 at a pressure of 13.1 atm as the dielectric radiator. The corresponding index of refraction is 1.005 69. Cosmic-ray μ-mesons with velocities greater than that of light in the gas were counted with an efficiency of (86 ± 2)%. Tests indicate that the efficiency for counting μ-mesons with velocities less than that of light in the gas is less than 3%. A.

537.542 : 621.395.625.3

3385. EIGHT-CHANNEL RECORDING ON ¼ IN. MAGNETIC TAPE WITH A STATIONARY-TAPE PLAYBACK. J.C.Barton.
J. sci. Instrum., Vol. 33, No. 11, 415-19 (Nov., 1956).

A method of constructing multi-channel magnetic heads is described and their performance reported. The problem of interference between channels is discussed and details given of a new technique for reducing this interference. The playback equipment consists of an eight-channel head mounted on an electrically maintained tuning fork so that it picks up signals from a stationary tape. Signals from each channel are switched electrically in time succession and, after amplification, displayed simultaneously on an oscilloscope. It is possible to resolve pulses recorded along the tape at a separation of 0.1 mm. Precautions necessary for observing very small signals are discussed. This apparatus was developed in connection with the portable cosmic-ray hodoscope described in Abstr. 6731 (1956). A.

537.542

3386. A FAST COINCIDENCE SYSTEM FOR THE MEASUREMENT OF SHORT LIFETIMES. G.Jones and J.B.Warren.
J. sci. Instrum., Vol. 33, No. 11, 429-31 (Nov., 1956).

Details are given of a system comparable to that developed by Bell, Graham and Petch but employing the scheme of Neilson and James in which the time separation of associated events is converted to pulse amplitude and sorted on a conventional kicksorter. In this manner the whole coincidence resolution curve is obtained at one time while retaining an inherent time resolution of about 2×10^{-10} s. A.

537.542

3387. AN IMPROVED IONIZATION GAUGE CONTROL CIRCUIT. P.Hariharan and M.S.Bhalla.
J. sci. Instrum., Vol. 33, No. 12, 488-91 (Dec., 1956).

In this unit, the heating power for the ionization gauge filament is supplied by an audio amplifier fed from an internal oscillator. Stabilization of the electron current, for wide variations in the emissive characteristics of the filament, is achieved by a negative feedback loop which controls the gain of the amplifier. Ion currents ranging from 100 to 0.01μ A are read on a single logarithmic scale by utilizing the retarding field characteristics of a triode. This eliminates range switching and is particularly advantageous for multipoint reading or continuous recording of pressures. A.

537.542

3388. FAST DIFFERENTIAL ANALYZER. H.A.Lamonds.
Nucleonics, Vol. 14, No. 8, 86-90 (Aug., 1956).

A single-channel pulse height analyser avoiding delaying and stretching techniques by using a feedback circuit to achieve time-coincidence of the pulses from two conventional discriminators. The resolving time is 0.4μs. R.D.Smith

537.542

3389. MILLIMICROSECOND TIME ANALYZER. C.Cottini and E.Gatti.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1550-7 (Dec., 1956).

A millimicrosecond time analyser is described. For artificial pulses of 0.1 V minimum amplitude and some mμsec width, the resolving power is about 5×10^{-11} sec. The instrument works on frequency conversion of two high-frequency sinusoidal damped waves ballistically excited by the input pulses. A.

537.542

3390. GRAPHICAL DETERMINATION OF THE PATH OF A SCATTERED PARTICLE. N.C.Barford and G.T.Reynolds.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 929-32 (Oct., 1956).

A method is described for determining the path length of a particle in a multiplate cloud chamber in which there is evidence for scattering during traversal of an individual plate. The method, though graphical, has an analytical basis. A.J.Egginton

537.542

3391. THE USE OF MULTIPLE SCATTERING AND THE EFFECTS OF DISTORTION IN A HIGH-PRESSURE CLOUD CHAMBER. P.Baxter and F.R.Stannard.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 17-25 (Jan., 1957).

Multiple scattering measurements on tracks of high energy ionizing particles in a high-pressure cloud chamber are described, and the use of such measurements for estimating the product, $p\beta$, of momentum and velocity of the particles is discussed. Q-values of Λ^0-decays and the masses of particles stopping in the chamber are deduced from such measurements. The various distortions found in this type of chamber and their effect on multiple scattering measurements are discussed. A.

537.542

3392. PROPANE BUBBLE CHAMBER IN A HIGH MAGNETIC FIELD. L.O.Oswald.
Rev. sci. Instrum., Vol. 28, No. 2, 80-3 (Feb., 1957).

A liquid propane chamber 3.25 by 6.5 by 13 in., operating in a magnetic field of 22 000 gauss, is described. A simple compact darkfield type of illumination is used; this is discussed. For personnel and equipment safety a secondary pressure vessel is incorporated in the design. Special reference is given to some of the construction and design problems. A brief summary of the operation of the propane chamber in the 6.2 BeV neutron beam is given. A.

537.543 : 621.385.2

3393. TRANSIENT PROCESSES IN A PLANE DIODE WITH AN EXTERNAL MAGNETIC FIELD. Yu.V.Pimenov.
Zh. tekh. Fiz., Vol. 26, No. 9, 1955-65 (1956). In Russian.

A theoretical treatment of the current-rise mechanism in a plane diode with a magnetic field parallel to the electrode plates, subjected to a square voltage pulse. The case of infinite cathode emission and constant anode voltage is discussed in detail. J.B.Arthur

IONIZATION. THERMIONICS 537.56/.58

537.56 : 537.572

3394. TOTAL CHARGES AND ELECTRON CAPTURE CROSS-SECTIONS OF FISSION FRAGMENTS IN GASES. N.O.Lassen.
K. Danske Vidensk. Selsk., mat.-fys. Medd., Vol. 30, Paper 8, 12 pp. (1955).

The variation of the mean charge of fission fragments has been examined during their passage through certain solids and gases at various pressures. The equilibrium charges are found to vary in the expected fashion with both velocity and the medium traversed. The effective cross-section in units πa_0^2 (a_0 = radius of the H atom in the ground state) have been calculated for various gases and for several velocities for both the light and heavy fission fragments. Good agreement is obtained with the theoretical values computed by the methods of Bohr and Lindhard. D.J.A.Prowse

537.56 : 537.571 : 533.7 : 532.7

ON THE DYNAMICS OF A NON-UNIFORM ELECTRICALLY CONDUCTING FLUID. See Abstr. 3052

537.561 : 537.527

3395. STATIC BREAKDOWN IN UNIFORM FIELDS AND PRECISION MEASUREMENT OF IONIZATION COEFFICIENTS. R.W.Crompton, J.Dutton and S.C.Haydon.
Appl. sci. Res. B, Vol. 5, No. 1-4, 43-6 (1955).

Briefly reviews the results of recent experiments on the growth of pre-breakdown ionization currents in air and nitrogen at high pressures and their theoretical consequences, and reports the extension of the investigation to the accurate determination of the primary and secondary ionization coefficients in hydrogen. J.Dutton

537.561

3396. MASS SPECTROMETER APPEARANCE POTENTIALS FOR POSITIVE ION FRAGMENTS FROM BF_3, $B(CH_3)_3$, $B(C_2H_5)_3$, $B(OCH_3)_3$ AND $HB(OCH_3)_3$. R.L.Law and J.L.Margrave.
J. chem. Phys., Vol. 25, No. 5, 1086-7 (Nov., 1956).

Tabulates relative abundances for fragments from bombarded substituted boranes and appearance potentials for positive ions from O_2, N_2, CH_3Cl and some substituted boranes. C.G.Morgan

537.561

3397. ELECTRON IMPACT STUDIES ON C_2H_5Cl, C_2H_5Br, AND C_2H_5I. A.P.Irsa.
J. chem. Phys., Vol. 26, No. 1, 18-22 (Jan., 1957).

The appearance potentials and process of formation of the $C_2H_5X^+$, $C_2H_5^+$, CH_2X^+, and HI^+ ions have been studied. From the appearance potential data evidence is obtained for the following processes of production of these ions

$$C_2H_5X + e = C_2H_5X^+ + 2e \quad (a)$$

$$C_2H_5X + e = C_2H_5 + X + 2e \quad (b)$$

$$C_2H_5X^+ + e = CH_2X^+ + CH_3 + 2e \quad (c)$$

$$\text{or} \qquad = CH_2X^+ + CH + H_2 + 2e$$

$$C_2H_5I + e = HI^+ + CH_2 = CH_2 + 2e. \quad (d)$$

These processes and their corresponding appearance potentials permit certain ionization potentials and bond energies to be derived. The ionization potentials obtained for the ethyl halides are $I(C_2H_5Cl) \leq 11.2 \pm 0.2$ eV, $I(C_2H_5Br) \leq 10.7 \pm 0.1$ eV, and $I(C_2H_5I) \leq 9.6 \pm 0.2$ eV. The carbon—halogen bond energies of these ethyl halides as determined from process (b) are $(C-Cl) \leq 3.6 \pm 0.3$ eV, $(C-Br) \leq 2.8 \pm 0.2$ eV, and $(C-I) \leq 2.4 \pm 0.4$ eV. Values of the carbon—carbon bond energy of C_2H_5Br and the ionization potential of CH_2Br are estimated to be 3.6 and 9.1 eV respectively. The ionization efficiency curves of the negative halogen atoms from the ethyl halides are presented and some of their features discussed. A.

537.562

3398. TOWNSEND'S FIRST IONIZATION COEFFICIENT IN NITROGEN. M.A.Harrison.
Phys. Rev., Vol. 105, No. 2, 366-8 (Jan. 15, 1957).

Measurements of Townsend's first ionization coefficient, α, have been made in nitrogen for values of E/p from 24 to 82. The ionization coefficient α is the mean number of ionizations per cm in the field direction produced by electron collision. E is the electric field strength measured in volts per cm and p is the pressure in mm of mercury. Sodium azide was used as a nitrogen source in an effort to obtain pure nitrogen. Data were also taken in tank nitrogen and mass spectrographic analyses of gas from both sources were made. No impurities were detectable in the sodium-azide-produced gas, while the tank nitrogen was found to contain some contamination even after a purification process. Results at low values of E/p differ considerably from previously reported data, while at high values the results agree very well with data obtained by Bowls. Values of α/p in tank nitrogen were found to be considerably lower at low E/p than those found in gas produced from sodium azide, although at high

values the difference was small. The effect of wall potential on α/p was investigated and was found to be unimportant over a range from 45% to 100% of anode potential. A.

537.562 : 537.533

3399. THE LATERAL DIFFUSION OF AN ELECTRON SWARM IN A MAGNETIC FIELD. R.J.Bickerton.
Proc. Phys. Soc. B., Vol. 70, Pt 3, 305-13 (March, 1957).

The lateral spreading of a swarm of electrons moving through a gas in parallel electric and magnetic fields is measured. Currents of between 10^{-5} and 10^{-10} ampere are passed through helium, neon and hydrogen at pressures of the order 1 mm Hg. Agreement with theory is found for the influence of the magnetic field on the diffusion and mobility of the electrons. The effects of space charge and of secondary processes can also be predicted quantitatively. A.

537.564

3400. TWO-ELECTRON CHARGE-EXCHANGE OF α-PARTICLES IN HELIUM. V.I.Gerasimenko and L.N.Rozentsveig.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 684-7 (1956). In Russian.

The cross-section for capture of two electrons by a fast alpha-particle colliding with a helium atom has been computed in the Born approximation. A.

537.568

3401. ON THE USE OF THE COMPLETE INTERACTION HAMILTONIAN IN ATOMIC REARRANGEMENT COLLISIONS. J.D.Jackson.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 26-33 (Jan., 1957).

The use of the complete interaction Hamiltonian in the problem of the transfer of an electron from a hydrogen-like target atom with nuclear charge Ze to an incident ion of charge Z'e is discussed both qualitatively and quantitatively. The second Born approximation is examined in detail, and it is shown that for Z' = Z = 1 the second Born approximation correction to the matrix element very nearly vanishes when the complete interaction Hamiltonian is employed. This gives a theoretical explanation for the good agreement between theory and experiment for electron capture by protons in hydrogen even at incident velocities such that $\hbar v/e^2 \sim 1$, and the poor agreement for alpha-particles in hydrogen in the same velocity range. A.

537.571 : 539.172

3402. MEASUREMENT OF THE IONIZING POWER OF PARTICLES IN A BUBBLE CHAMBER. G.A.Blinov, Yu.S.Krestnikov and M.F.Lomanov.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 762-70 (1956). In Russian.

The possibility of measuring the ionizing power of particles in a propane bubble chamber is demonstrated. The chamber was operated in conjunction with an accelerator. Stable chamber operation which is required in ionization measurements could be attained by applying the method of reducing the pressure to a constant adjustable value. The sensitivity time was as high as 40 msec. Track-density measurements of the ionizing power of particles were performed between the minimal value and a value 80 times larger. For velocities $\beta < 0.6$ the track density varied as $1/\beta^2$. A relativistic increase in the track density was observed for velocities approaching that of light. The methods used in reducing the track data are described. A.

537.583

3403. DONOR CONCENTRATION CHANGES IN OXIDE-COATED CATHODES RESULTING FROM CHANGES IN ELECTRIC FIELD. H.J.Krusemeyer and M.V.Pursley.
J. appl. Phys., Vol. 27, No. 12, 1537-45 (Dec., 1956).

Large reproducible changes in work function of oxide cathodes have been observed following step-like changes in d.c. current drawn from, as well as to, the coating. One type, with a time constant in the range of 10^{-2} to 1 sec, has been reported by others. It appears to be caused by a redistribution of donors by the field set up in the coating. This phenomenon has now been studied as a function of temperature, d.c. current density, coating composition, and barium deposition. A second type of transient which follows the first, was also observed. It has a time constant, in the range from 100 to 10^4 sec. The amplitude of this change is of the same order as that of the first. The time dependence is in most cases given by a simple exponential. Both amplitude and time constant are a function of the cathode itself as well as its environment. This transient is thought to be caused by a change of the total number of donors. A simple analysis accounting for the exponential form yields values for the donor loss rate A.

537.583 : 536.422

3404. THE EVAPORATION OF BARIUM FROM "L" CATHODES. I.Brodie and R.O.Jenkins.
J. Electronics, Vol. 2, No. 1, 33-49 (July, 1956).

The rate of evaporation was measured by exposing a W wire to the L-cathode and determining the time for electron emission from the W wire to reach a maximum. The average coverage for max. emission was taken (de Boer) as 2.3×10^{-8} g/cm^2 but the effect of the use of a circular wire was to modify this figure to 3.5×10^{-8} g/cm^2. The rate of evaporation was determined as function of L-cathode temperature for several cathodes with different porosities. The results confirm the hypothesis that the evaporation rate is limited by Knudsen flow in the pores of the cathode, provided the porosity is not very great. Some thermo-chemical calculations on reaction rates are included. A.H.W.Beck

537.583

3405. MIXED MONOLAYERS OF BARIUM AND CALCIUM ON TUNGSTEN. I.Brodie and R.O.Jenkins.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1343-4 (Dec., 1956).

The emission from mixed monolayers of Ba and Ca on a W wire shows a maximum when Ca is present to the extent of 25%. The emission is then about double that observed from a Ba monolayer. If this is interpreted as a lowering of the work function, a value of $\Delta\phi = -0.05$ eV is obtained. A.H.W.Beck

COSMIC RAYS 537.591

537.591.1 : 523.841.11

3406. EXPLOSIONS OF SUPERNOVAE AND THE PROBLEM OF THE ORIGIN OF THE ELECTRONIC COMPONENT OF COSMIC RAYS. I.M.Gordon.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 413–16 (1954). In Russian.

The presence of a small but finite component of extremely energetic electrons in the primary cosmic radiation may have its origin in supernova explosions. Some speculative estimates are made about the distribution (in space, time and energy) of such explosions which would account for the observed electronic component (including its energy spectrum) and at the same time be consistent with present astrophysical data about supernovae. J.W.Gardner

537.591.1

3407 NEW DETERMINATION OF THE INTENSITIES OF PRIMARY COSMIC RAY ALPHA PARTICLES AND Li, Be, B NUCLEI AT $\lambda = 41.5^0$ USING A ČERENKOV DETECTOR. W.R.Webber.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1285- 306 (Dec., 1956).

Measurements of the intensities of the α-particles and Li, Be, B nuclei in the primary cosmic radiation have been made at an average atmospheric depth of 18.5 g/cm^2 in two "Skyhook" balloon flights at $\lambda = 41.5^0$. The measuring instrument consisted of a thin (3.0 g/cm^2) Cherenkov detector placed within the solid angle of a Geiger counter telescope. This detector yielded unusually good resolution of the α-particle and Li, Be, B components. This fact and the slow rate of rise of the two balloons made possible a detailed determination of the dependence of α-particle intensity on atmospheric depth. The quality of the data justified a new approach to the problem of extrapolating the α-particle intensity to the top of the atmosphere. This extrapolation was carried out by applying a "diffusion" equation of the type previously used for nuclei with $Z > 2$ to the observed pressure-altitude dependence of α-particle intensity. The resulting estimate of the α-particle intensity at the top of the atmosphere is significantly lower than previous estimates. At 18.5 g/cm^2 the sum of the vertical intensities of the Li, Be, B components was found to be (3.11 ± 0.31) m^{-2} sterad^{-1} sec^{-1} and the intensities $J_{Li} : J_{Be} : J_B$ were found to be as 3 : 4 : 2. The (light nuclei/medium nuclei) intensity ratio at the top of the atmosphere as determined by this experiment was 0.35 ± 0.09. The vertical intensities at the top of the atmosphere of the various components of the primary radiation as obtained in this experiment at $\lambda = 41.5^0$ were:

Component	(J^0 m^{-2} sterad^{-1} sec^{-1})
protons	≤ 526
α-particles	74 ± 5
Li, Be, B	2.28 ± 0.55
$Z \geq 6$	9.2 ± 1.2

A.

537.591.1

3408. ABSOLUTE INTENSITY OF LOW-ENERGY COSMIC-RAY μ MESONS. A.Fafarman.
Phys. Rev., Vol. 104, No. 4, 1116-19 (Nov. 15, 1956).

A cylindrical plastic scintillator weighing one kilogram has been used as both the absorber and the detector for the stopping of (omni-directional) low-energy cosmic-ray μ mesons. Simultaneous delayed coincidences in each of two photomultipliers that view the scintillator serve to identify the decays of stopped mesons. A correction is made for mesons that decay outside the recorded delay intervals. A further correction is made for edge effects (decay beta-particles which escape from the scintillator with insufficient energy loss to actuate the detector). The number of stopping mesons of average range 7 g/cm^2 (air equivalent) is $7.29 \pm 0.21 \times 10^{-6}$ sec^{-1} g^{-1}. Assuming a $\cos^3\theta$ distribution yields for the vertical intensity $4.64 \pm 0.13 \times 10^{-6}$ g^{-1} sec^{-1} sterad^{-1}. A.

537.591.1

3409. DIRECT DETERMINATION OF PRIMARY COSMIC-RAY ALPHA-PARTICLE ENERGY SPECTRUM BY NEW METHOD. F.B.McDonald.
Phys. Rev., Vol. 104, No. 6, 1723-9 (Dec. 15, 1956).

The flux of cosmic-ray alpha-particles has been measured at $\lambda = 41^\circ$N and 55°N and the energy spectrum in the region 883-285 MeV/nucleon has been determined by the use of a combination of a scintillation and Cherenkov counter. This spectrum is not dependent on geomagnetic theory. It has been found that the integral alpha-spectrum can be fitted with the function

$$J_{0\alpha}(E) = \frac{431}{(1+E)^{1.4\pm0.2}} \text{ particles/m}^2\text{-sec-sterad},$$

and

$$J_{0\alpha}(E_1) = 87 \pm 9 \text{ particles/m}^2\text{-sec-sterad}, \quad \lambda = 41^\circ\text{N},$$

$$J_{0\alpha}(0.285 \text{ BeV}) = 292 \pm 25 \text{ particles/m}^2\text{-sec-sterad}, \quad \lambda = 55^\circ\text{N}.$$

$J_{0\alpha}(E)$ is the flux of α-particles at the top of the atmosphere with kinetic energy $\geq E$ (in BeV/nucleon). E_1 is the cutoff energy/nucleon for α-particles at 41°N. An absorption mean-free-path $\lambda_\alpha = 45 \pm 7$ g/cm^2 has been measured for alpha-particles. The properties of this new detector are discussed and a study is made of the energy response of the Cherenkov counter to fast multiply-charged particles. A.

537.591.1 : 537.591.8

3410. COMPARISON OF THE FERMI–LANDAU THEORY WITH SOME EXPERIMENTAL DATA ON COSMIC RAYS. O.A.Guzhavina, V.V.Guzhavin,and G.T.Zatsepin.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 819-30 (1956). In Russian.

The energy spectrum of secondary particles created in high-energy (10^{12}-10^{18} eV) nuclear collisions was computed on the basis of the Landau theory. The spectra thus obtained were used to compute the altitude dependence of nuclear-active particles in the atmosphere and also to determine the high-energy μ-meson flux at sea-level. Results of the computations are compared with the experimental data. A.

537.591.1

3411. ON THE MASS SPECTRUM OF CHARGED COSMIC-RAY PARTICLES. A.I.Alikhanyan, N.V.Shostakovich, A.T.Dadayan, V.N.Fedorov, and B.N.Deryagin.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 955-70 (1956). In Russian.

Results of investigation of the mass spectrum of cosmic-ray particles at an altitude of 3200 m are presented. The measurements were carried out with a magnetic mass spectrometer in conjunction with a proportional counter and two cloud chambers. Among the particles, which are locally generated above the apparatus,protons, deuterons, π-mesons and K-particles were observed. 11 cases are discussed of particles with masses between 500 and 600 m_e which were stopped in the lower chamber. In none of these cases a star or a shower was observed in the upper chamber. For several of these particles it was certain that they got into the chamber from without, as it is the case for μ-mesons. A.

537.591.15

3412. ANALYSIS OF AN ELECTRON SHOWER ASSOCIATED WITH A VERY ENERGETIC He NUCLEUS. N.Seeman and R.G.Glasser.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 703-12 (Oct., 1956).

An event has been observed which is interpreted as the direct production of an electron pair by a helium nucleus of the cosmic radiation. The primary helium nucleus has a measured energy of $(1.7 \pm 0.5) \times 10^5$ GeV. The pair has an energy of 20 ± 4 GeV and initiates an electron shower. A.

537.591.15

3413. A HIGH ENERGY NUCLEAR INTERACTION. A.Debenedetti, C.M.Garelli, L.Tallone and M.Vigone.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1142-50 (Nov., 1956).

The values of $p\beta$ of the secondaries of a high-energy jet were determined from scattering measurements. The angular and momentum distributions in the centre-of-mass system were calculated and a good agreement with Heisenberg's and Wataghin's theories was found. Also the value of the percentage of K-mesons emitted in the nuclear interaction and an estimate of the mean free path for nuclear interactions of the charged π-mesons are given. A.

537.591.15

3414. A STUDY ON ELECTROMAGNETIC SHOWERS IN NUCLEAR EMULSIONS. A.Debenedetti, C.M.Garelli, L.Tallone and M.Vigone.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1151-9 (Nov., 1956).

A considerable number of electromagnetic cascades have been analysed to determine the increase of the multiplicity with the primary energy, the spectrum of the energies of the secondaries and the trident production. No appreciable discrepancy from the theory has been noticed. A.

537.591.15

3415. A HIGH ENERGY JET IN NUCLEAR EMULSIONS. F.D.Hänni, C.Lang, M.Teucher, H.Winzeler and E.Lohrmann.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1473-8 (Dec., 1956).

A nuclear interaction of the type 20 + 56p was found in an emulsion flown at 29 km altitude in Texas. In the very dense core of this jet 6 secondary interactions were found, 4 of which are produced by singly charged primaries, the other 2 by neutral particles. The average energy of these secondary interactions is about 200 GeV. From this and from the angular distribution of the primary jet an energy of 10^{13} eV is deduced. The interaction mean-free-path of the charged particles in the core is 54^{+56}_{-21} cm. A.

537.591.15

3416. THE DENSITY DISTRIBUTION OF EXTENSIVE SHOWERS. J.R.Prescott.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 870–4 (Nov., 1956).

The rates of occurrence of extensive showers have been measured as a function of their density. The slope of the distribution is shown to increase significantly at high densities. An explanation of disparities between single and double ionization chamber systems is given in terms of the structure of the shower. A.J.Egginton

537.591.15

3417. INVESTIGATION OF HIGH-ENERGY ELECTRON SHOWERS BY THE EMULSION CAMERA TECHNIQUE. I.M.Gramenitskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 710-12 (1956). In Russian.

The camera, which consisted of 24 photographic plates, was exposed for 4 hours at a height > 20 km. The number of particles as a function of distance is in agreement with the cascade theory for energies $E_0 \sim 10^{12}$ eV. G.E.Brown

537.591.15

3418. INFLUENCE OF THE EARTH'S MAGNETIC FIELD ON THE SPATIAL DISTRIBUTION OF PARTICLES IN WIDE ATMOSPHERIC SHOWERS. S.I.Nikol'skiĭ and I.E.Satsevich.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 714-15 (1956). In Russian.

For counters placed 18 m from the centre of the shower, no effect is observed, but when they are placed 100 m, a small effect is found, corresponding to an increase in the radius of the shower of about 6-10% in the east–west direction. G.E.Brown

537.591.15

3419. SPATIAL DISTRIBUTION OF PARTICLES IN EXTENSIVE ATMOSPHERIC SHOWERS PRODUCED BY PRIMARY COSMIC RAYS OF VARIOUS ENERGY. S.P.Debrovol'skiĭ, S.I.Nikol'skiĭ, E.I.Tukish and V.I.Yakovlev.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 939–42 (1956). In Russian.

Within the experimental errors the spatial distribution was found to be independent of the primary particle energy from 10^{13} to 6×10^{15} eV. A.

537.591.3

3420. THE CHARACTER OF THE ABSORPTION OF COSMIC-RAY PARTICLES AT VARIOUS ALTITUDES. S.N.Vernov, V.A.Gladyshev, V.M.Filatov, A.N.Charakhch'yan and T.N.Charakhch'yan.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 425-7 (1954). In Russian.

With the help of counter coincidences the intensity of cosmic-ray particles passing through various absorber thicknesses (1.2,

2.0 and 6.6 g/cm² of Al, 11.4, 22.8 and 114 g/cm² of Pb) has been measured as a function of the altitude, up to 35 g/cm² of atmospheric pressure, at the geomagnetic latitude 51°N. The telescopes have been sent up in stratospheric balloons and the data were recorded via radio. A description of the apparatus is given, and possible interpretations of the results are discussed. G.Martelli

537.591.5

3421. CORRELATION OF METEOROLOGICAL PARAMETERS WITH COSMIC-RAY NEUTRON INTENSITIES. J.A.Lockwood and H.E.Yingst.
Phys. Rev., Vol. 104, No. 6, 1718-22 (Dec. 15, 1956).

The correlation of variations in the neutron intensity of cosmic radiation with variations in meteorological conditions has been investigated at 6262 ft and at sea level over the period from 1952 to 1955. A low-energy directional neutron detector was operated during the summer months of this period to monitor the intensity of neutrons with energies less than 0.5 eV. In addition a lead–paraffin pile detector was used to monitor the moderate energy neutrons. From the partial correlational analysis for the low-energy neutron intensity the following regression coefficients are obtained: barometric pressure (-10.9 ± 0.9) %/cm Hg; specific humidity (-2.0 ± 2.5) %/0.01 S, where S is the local specific humidity; local atmospheric temperature (-0.07 ± 0.09) %/deg F. For the moderate-energy neutron detector the only significant regression coefficient obtained is for barometric pressure, $\alpha = (-9.70 \pm 0.15)$ %/cm Hg. The results for the dependency of neutron intensity upon barometric pressure and temperature are in agreement with the predicted values, but the results for the specific humidity correlation do not agree with the theoretical predictions. The significance of the latter result is discussed. Experiments have also been made to determine the energy spectrum of low-energy neutrons at ground elevations by using paraffin moderators of different thicknesses placed over the low-energy directional neutron detector. The observed proportion of neutrons with energy exceeding 0.6 eV is less than predicted theoretically. A.

537.591.8

3422. ON THE INTERACTION OF COSMIC RADIATION WITH MATERIALS AT 32 M.W.E. AND 200 M.W.E. UNDERGROUND. S.Higashi, I.Higashino, M.Oda, T.Oshio, H.Shibata, K.Watanabe and Y.Watase.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1021-9 (Oct., 1956).

Penetrating showers produced in lead and some other phenomena have been studied at 32 m.w.e. and 200 m.w.e. below the top of the atmosphere and at sea level with a counter hodoscope. As much care as possible were taken to avoid uncertainties of the counter hodoscope study. The threshold energy of the penetrating showers observed was estimated as about 7 BeV taking into account the geometrical condition of the apparatus. The cross-section for the penetrating showers at 32 m.w.e. was found to be $(2.8 \pm 0.7)\,10^{-31}$cm²/nucleon and about a ten times larger cross-section was obtained at 200 m.w.e. Those events which were interpreted as the mixed shower coming from the earth above the apparatus were also studied. The energy involved in this phenomena has been estimated to be very high and the cross-section is suggested. Occasionally two or more penetrating particles traversed the apparatus in parallel with each other without being accompanied with soft components. The intimate association of air showers with these events is concluded. A.

537.591.8 : 539.172.13

3423. HIGH ENERGY NUCLEAR INTERACTIONS IN LEAD BY COSMIC RAY PROTONS AT 3500 m. R.Giacconi, A.Lovati, A.Mura and C.Succi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 826-33 (Oct., 1956).

A multiplate cloud chamber, triggered by G.M. counters, has been operated at 3500 m above sea-level to investigate high-energy nuclear interactions in lead by cosmic ray protons. A study is made of the development of the nuclear cascade in lead. The angular distribution of the secondary interacting particles, the characteristics of the successive interactions of the cascade, the mean free path for nuclear interaction of the secondary ionizing particles have been analysed. For the shower particles produced in high-energy interactions (by protons of mean energy 50 GeV), similar to the jets of nuclear emulsions, the mean free path is found to be geometrical. Associated with the 786 interactions seen in the chamber, 15 V^0 and 3 $V^{\pm}$ particles have been observed. The distribution of the angles between the production plane and the decay plane of the V^0 is given. A.

MAGNETISM 538

538.082 : 621.317.431

3424. SIMPLE 60-c.p.s. HYSTERESIS LOOP TRACER FOR MAGNETIC MATERIALS OF HIGH OR LOW PERMEABILITY. D.H.Howling.
Rev. sci. Instrum., Vol. 27, No. 11, 952-6 (Nov., 1956).

By including a differential form of balance control, all 60 c/s voltage present in the leads and pick-up coils, prior to the insertion of a magnetic specimen into the field coils, may be completely balanced out. The sensitivity is sufficient to provide a one-inch peak to peak deflection on a Dumont 304A cathode-ray oscilloscope for a flux change of 0.1 maxwell. A.

538.082

3425. CONTINUOUSLY INDICATING PRECISION MAGNETOMETER. G.W.Green, R.C.Hanna and S.Waring.
Rev. sci. Instrum., Vol. 28, No. 1, 4-8, (Jan., 1957).

A flat coil is suspended in a magnetic field so that in equilibrium it is coplanar with the field and can oscillate about an axis in the plane of the coil perpendicular to the field. When an alternating current is passed through the coil the system behaves as an inductance in series with a condenser of capacity inversely proportional to the square of the magnetic field. The principle has been applied to the measurement of magnetic field. The instrument is capable of a precision of one part in 10^2 with simple auxiliary apparatus. The application to a particle analyzing magnet is described. With some elaboration the magnetic field can be measured and stabilized to one part in 10^4 in the range 1-12 kilogauss. A.

538.113 : 538.221

3426. DIAMAGNETIC RESONANCE IN STRONGLY MAGNETIC BODIES. Ya.G.Dorfman.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 2, 201-2 (1956). In Russian.

A qualitative discussion of the resonance due to the orbital motion of the current carriers — electrons or holes — in the internal magnetic field of a ferromagnetic or uncompensated antiferromagnetic material. The resonance frequency should fall from $\sim 10^{13}$ c/s when $H_{int} \sim 10^6$ Oe to radio frequencies as the temperature is raised towards the Curie point. Weak external fields should affect the polarization and sharpness of the resonance but not its frequency. D.H.Whiffen

538.113

3427. THEORY OF THE DIAMAGNETISM OF BLOCH ELECTRONS. T.Kjeldaas,Jr and W.Kohn.
Phys. Rev., Vol. 105, No. 3, 806-13 (Feb. 1, 1957).

Deals with the diamagnetic susceptibility of a degenerate gas of Bloch electrons in a cubic lattice. It is shown that the effective Hamiltonian of such electrons in a magnetic field is rigorously a particular power series in P of the form $\tilde{H} = E(P)$, where $P = (\hbar/i)\nabla - (e/c)A$ and $E(\hbar k)$ is the energy of the band in question. (Because of the noncommutativity of the components of P, $E(\hbar k)$ does not determine E(P) uniquely. E(P) is not a symmetrized power series in the components of P.) By expanding E(P) in powers of P, one is led to a series expansion for the diamagnetic susceptibility of the form

$$\chi = -\frac{e^2 k_0}{12\pi^2 mc^2}\left(\frac{m}{m^*} + c_2 k_0^2 + c_4 k_0^4 + \cdots\right),$$

where $k_0 = (3\pi^2 n)^{1/3}$ and n is the number of electrons per unit volume. (For a spherical band, k_0 is the wave number on the surface of the Fermi sea). The first term of this series is the well-known Landau–Peierls expression, the higher terms are corrections to it. In the tight binding approximation the second term becomes dominant and reduces correctly to the atomic diamagnetism. The first two terms of this series have been calculated for Li and Na. For Na the second term was found to be very small; for Li it is more than half as large as the first and of opposite sign. Numerical results are $\chi_{Li} = -0.074 \times 10^{-6}$ and $\chi_{Na} = -0.26 \times 10^{-6}$ c.g.s. volume units. A.

538.114

3428. A NOTE ON THE FERROMAGNETIC RESONANCE IN α Fe_2O_3. M.Shimizu.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1078-83 (Oct., 1956).

Microwave resonance formulae are phenomenologically derived for a ferromagnet with a small hexagonal anisotropy in a basal plane, with uniaxial anisotropy. Comparison with resonance experiments on α Fe_2O_3 single crystals is made and satisfactorily explained. A few contradictions with static measurements are pointed out. A.

538.114

3429. THE SPIN WAVE THEORY OF FERROMAGNETISM. D.Frank and K.Meyer.
Naturwissenschaften, Vol. 43, No. 16, 371-2 (1956). In German.

Indications are given that spin waves obey Fermi–Dirac statistics and the consequences of this idea are developed; a number of difficulties of earlier treatments are removed. E.P.Wohlfarth

538.114

3430. A CONTRIBUTION TO THE THEORY OF THE COERCIVE FORCE OF THIN SHEETS. J.Kaczér.
Czech. J. Phys., Vol. 6, No. 4, 310-20 (Aug., 1956). In Russian.

On the basis of the known model of the Bloch wall the magnetostatic energy density of the surface charges produced by the intersection of the wall with the surface of a single crystal is calculated. It is shown that this energy is not negligible as compared to the other energies (energy of exchange and anisotropy) and that is has to be taken into account in the case of thin sheets. As a consequence of this the energy density γ of the sheet is larger than in the unbounded crystal. It is also shown that the thickness of the Bloch wall is a function of the thickness of the sheet. An expression is calculated for the coercive force of thin sheets as a function of the thickness of the sheet which, in the case of single crystal sheets, is in very good agreement with experiment. For polycrystalline sheets, however, only qualitative agreement is obtained, the values calculated being smaller than those measured. It is shown, however, that agreement can also be obtained if a constant magnetostatic surface energy is assumed which is probably due to additional charges on the surfaces of the sheet. The experimental value of the energy of these charges for polycrystalline silicon iron sheet is about 4 erg/cm^2. A.

538.114

3431. MAGNETOSTATIC MODES IN FERROMAGNETIC RESONANCE. L.R.Walker.
Phys. Rev., Vol. 105, No. 2, 390-9 (Jan. 15, 1957).

It has been found recently that in ferromagnetic resonance experiments performed in inhomogeneous r.f. exciting fields at a fixed frequency, absorption of power takes place at a number of distinct magnetic fields. This is ascribed to the existence of long-wavelength modes of oscillation of the ferromagnetic sample. The mode spectrum of spheroids is examined for the case, which may often hold in practice, where exchange and electromagnetic propagation can be ignored simultaneously. A.

538.114

3432. FUNDAMENTAL THEORY OF FERRO- AND FERRIMAGNETISM. J.H.Van Vleck.
Proc. Inst. Radio Engrs, Vol. 44, No. 10, 1248-58 (Oct., 1956).

The presentation is centred around the four important forms of magnetic energy in ferromagnetic media: (I) the Zeeman energy of the elementary magnets in the applied magnetic field, (II) the classical electromagnetic interaction between dipoles, (III) the Heisenberg exchange energy, and (IV) the energy of anisotropy which is pseudodipolar or pseudoquadrupolar in structure but is attributable ultimately to rather recondite quantum-mechanical spin–orbit interaction. The primary cause of ferromagnetism is (III), and anisotropy arises from (IV). Domain structure and the concomitant hysteresis phenomena owe their existence to (II). The magnetic theory of the ferrites is in many ways simpler and less ambiguous than that for conducting ferromagnetic media, as there are no complications due to electron migrations. Néel's theory of ferrimagnetism explains the saturation magnetization and other properties of the ferrites. A.

538.114 : 538.222 : 539.152.2

MAGNETIC PROPERTIES OF $(Cu,Zn)K_2(SO_4)_2.6H_2O$. See Abstr. 2549

538.122

3433. MAGNETIC FIELD DISTRIBUTIONS FOR A SPHERE AND FOR AN ELLIPSOID. G.O.McClurg.
Amer. J. Phys., Vol. 24, No. 7, 496-9 (Oct., 1956).

The magnetic field distribution for a sphere in a uniform field is obtained by the usual method. This distribution is then transformed into the distribution for an ellipsoid in a uniform field by the method of conformal mapping. A.

538.22 : 536.48

3434. MAGNETIC SUSCEPTIBILITY OF DILUTE Cu ALLOYS AT LOW TEMPERATURES. F.T.Hedgcock.
Phys. Rev., Vol. 104, No. 6, 1564-7 (Dec. 15, 1956).

The temperature dependence of the magnetic susceptibility of a number of dilute copper–tin and copper–iron alloys has been measured between room temperature and 4.2°K. The results indicate an anomalous paramagnetism in the neighbourhood of the temperature of the observed resistance minimum in these alloys. Proposed models for the resistance minimum and impurity scattering are reviewed in the light of this new magnetic information. A.

538.22

3435. MAGNETIC PROPERTIES OF COBALT AND MANGANESE CARBONATES. A.S.Borovik-Romanov and M.P.Orlova.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 579-82 (1956). In Russian.

The magnetic properties of $MnCO_3$ and $CoCO_3$ have been investigated in the temperature range from 14°K to 300°K. It is found that the magnetic susceptibility rapidly rises below T_C(T_C = 31.5°K for $MnCO_3$ and T_C = 17.5°K for $CoCO_3$) and depends strongly on the field strength. To explain the observed anomalies it is suggested that below T_C the carbonates go over to the antiferromagnetic state in which the sublattice moments do not completely compensate each other. A.

538.221 : 621.318.1

3436. THE PHYSICS OF MAGNETIC MATERIALS. R.M.Bozorth.
Elect. Engng, Vol. 75, No. 2, 134-40 (Feb., 1956).

A review is given of the atomic structure of iron and the ferrites to show how magnetic phenomena may be explained, reference also being made to the domain theory. The properties of iron–silicon and iron–nickel alloys are discussed. It is stressed that basic phenomena should be understood if best engineering results are to be obtained from magnetic materials. G.F.Hodsman

538.221

3437. ON THE MAGNETIC PROPERTIES OF THE SYSTEM MnSb–CrSb. T.Hirone, S.Maeda, I.Tsubokawa and N.Tsuya.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1083-7 (Oct., 1956).

The change of magnetic properties due to the replacement of manganese by chromium in manganese antimonide (MnSb), which is of the NiAs structure, was incestigated. It was found that, with the increase of the concentration of chromium, the magnetic behaviour of these compounds $(Mn_{1-x}Cr_x)Sb$ changes as follows: (1) at $x = 0$ (MnSb), the temperature–magnetization curve shows the typical behaviour of a ferromagnetic substance, (2) in the range $0.1 \leq x \leq 0.7$, it deviates remarkably from the Weiss curve in proportion with the chromium content, and the temperature dependence of the reciprocal susceptibility above the Curie point is of a ferrimagnetic type. (3) In the range $0.8 \leq x \leq 0.9$ a transition from ferrimagnetic to antiferromagnetic was observed, and finally (4) at $x = 1$ (CrSb) a typical antiferromagnetism could be seen. A short discussion of such transitions is given. A.

538.221 : 538.66

3438. MAGNETO-THERMAL EFFECTS IN NICKEL AND COBALT. R.S.Tebble and R.W.Teale.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 51-64 (Jan., 1957).

Comprehensive measurements on the reversible and total magneto-thermal effect, the reversible susceptibility and the magnetization curves of annealed nickel and cobalt have been made. It is shown that, for reversible changes in magnetization, there is no significant change in the value of the "rotational" coefficient b" for nickel in high fields, and that reversible changes in intrinsic magnetization and rotations of the magnetization vectors must predominate. For cobalt, with a higher coercivity, these effects also predominate even in relatively low fields. There is no evidence of the reduction in the numerical value of b" in high fields, which has been deduced from the results of earlier work, and it is suggested that if any additional effects are present in high fields they must be irreversible. There is good agreement with the results of Tebble, Wood and Florentin and of Bates and his co-workers (Abstr. 1191, 7105/1951; 1759/1953; 8921/1955). A.

538.221

3439. COMMENTS ON THE NOTE BY W.P.OSMOND (1956) ON "THE TEMPERATURE-DEPENDENT RESISTIVITY OF CERTAIN IRON DEFICIENT MAGNESIUM MANGANESE FERRITES". L.C.F.Blackman.
J. Electronics, Vol. 2, No. 2, 199-200 (Sept., 1956).

Certain statements made by Osmond (Abstr. 533/1957) regarding the resistivity curve and the conduction in some Fe-deficient MgMn ferrites are criticized and plausible alternative explanations, supported by chemical evidence, are offered. H.J.H.Starks

538.221 : 538.61

3440. THE MAGNIFICATION OF THE MAGNETO-OPTIC KERR ROTATION BY MEANS OF EVAPORATED LAYERS. J.Kranz.
Naturwissenschaften, Vol. 43, No. 16, 370-1 (1956). In German.

If the surface of a polycrystalline Fe–Si specimen is covered

with an evaporated layer of SiO or ZnS the Kerr rotation is multiplied by factors 2.8 and 5.1 respectively and the contrast is also improved. E.P.Wohlfarth

538.221

3441. SPIN–SPIN ABSORPTION IN MANGANOUS CHLORIDE TETRAHYDRATE. E.Ambler and R.P.Hudson.
Phys. Rev., Vol. 104, No. 6, 1506-7 (Dec. 15, 1956).

Measurements on spin–spin absorption have been made on the antiferromagnetic substance, $MnCl_2 \cdot 4H_2O$, at temperatures from 1.3 to 4.2°K and at frequencies 1,2, and 4 Mc/s. The absorption shows a sharp peak at about 2.3°K and is proportional to the square of the frequency. At the highest temperatures an attempt has been made to compare the results with theory. The agreement is reasonable considering the extremely complicated situation where Stark splitting and dipolar, exchange and hyperfine coupling all are important. It is pointed out that an extension of this type of measurement to more simply behaved salts would be of considerable interest. A.

538.221

3442. ANTIFERROMAGNETIC STATE IN THE CHROME ALUMS. M.C.M.O'Brien.
Phys. Rev., Vol. 104, No. 6, 1573-9 (Dec. 15, 1956).

The molecular field method is applied to the magnetic interactions in the chrome alums to describe the ordered state that occurs at low temperatures. An antiferromagnetic Curie point is predicted even in the absence of any exchange between the chromium ions. The predicted critical temperature is $T_C = 1.7\tau(\sigma + v)$, where τ is the characteristic temperature, $15N\beta^2/k$, v represents the exchange interaction between nearest neighbours in units of the magnetic interaction, and $\sigma = 0.78$ is a sum of $(1-3\cos^2\theta)/r^3$ over lattice points. The entropy and susceptibility are calculated as functions of the temperature and applied field. The variation of the zero-field susceptibility with entropy below the critical temperature fits the observed results if v is put equal to −0.13, and this value of v gives a critical temperature within the range of observed values. A.

538.221

3443. FERROMAGNETIC RESONANCE IN THIN FILMS OF PERMALLOY. P.E.Tannenwald and M.H.Seavey,Jr.
Phys. Rev., Vol. 105, No. 2, 377-8 (Jan. 15, 1957).

Microwave resonance measurements have been made in evaporated (82% Ni, 18% Fe) films of thickness 760 A to 1600 A. The longest relaxation, as measured by the line width, gives $T_2 = 3 \times 10^{-8}$ sec. The sample thickness was equal to or less than the skin depth, resulting in a Lorentzian-type line. Multiple resonances were obtained according to shape anisotropy theory. A.

538.221

3444. MAGNETIC RESONANCE IN FERRITES. N.Bloembergen.
Proc. Inst. Radio Engrs, Vol. 44, No. 10, 1259–69 (Oct., 1956).

Ferromagnetic resonance in ferrites is reviewed. The concept of tensor permeability, the influence of magnetic anisotropy, demagnetizing fields, and damping mechanisms are discussed. Special consideration is given to coupled magnetic systems and the behaviour in ferrites with compensation points. The general theoretical results are compared with a few illustrative examples. The behaviour in polycrystalline material, g-value, line width, and anisotropy as a function of temperature and external magnetic field are outlined. A.

538.221

3445. MICROWAVE RESONANCE RELATIONS IN ANISOTROPIC SINGLE CRYSTAL FERRITES. J.O.Artman.
Proc. Inst. Radio Engrs, Vol. 44, No. 10, 1284-93 (Oct., 1956).

The ferromagnetic resonance relations in magnetically anisotropic single crystal ferrites are re-examined. Detailed analyses are presented for spherical specimens. Generalized nomograms are shown which relate the resonance frequency to static field H, anisotropy parameter K/M, and the static field orientation. The nature of the susceptibility tensor is discussed. Below magnetic saturation, multidomain structure is expected. Under these conditions, with H applied in a $\vec{H}$ applied in a [110] direction, a simple multidomain arrangement is suggested by crystal geometry. Ferromagnetic resonance can be used to investigate this structure. The analysis is similar to that employed for uniaxial crystals. The domains are lamellar in form, separated by 180° walls, and lie perpendicular to $\vec{H}$. Corresponding to the two nearby easy directions of magnetization, the domains are of two varieties which alternate in sequence. Two resonance frequencies are found for a given $\vec{H}$, depending on whether the microwave magnetic field is perpendicular or parallel to $\vec{H}$. Nomograms are given relating these resonance frequencies to $\vec{H}$, K/M, and saturation magnetization M. The nature of the magnetization curve for these simple structures is also discussed. The predictions of these analyses are compared with the results of recent experiments. A.

538.221

3446. ANISOTROPY OF COBALT-SUBSTITUTED Mn FERRITE SINGLE CRYSTALS. P.E.Tannenwald and M.H.Seavey.
Proc. Inst. Radio Engrs, Vol. 44, No. 10, 1343–4 (Oct., 1956).

The anisotropy of cobalt-substituted Mn ferrite single crystals has been measured by the usual microwave techniques. Both composition and temperature have been varied, with particular emphasis being placed on achieving zero or minimum anisotropy. A.

538.222/.224

3447. MAGNETIC SUSCEPTIBILITY OF DILUTE ALLOYS OF NICKEL IN COPPER BETWEEN 2.5°K AND 295°K. E.W.Pugh, B.R.Coles, A.Arrott and J.E.Goldman.
Phys. Rev., Vol. 105, No. 3, 814-18 (Feb. 1, 1957).

The magnetic susceptibilities of pure Cu and dilute Cu–Ni alloys containing 0.59, 1.16, and 2.48 atomic % Ni have been measured by a Gouy method at temperatures between 295°K and 2.5°K. At room temperature all the alloys were found to be diamagnetic, the numerical value of the susceptibility decreasing with increasing nickel content, as found by earlier workers. The paramagnetic contributions found at low temperatures were, however, considerably smaller than those previously reported, although the 2.48% alloy was paramagnetic at temperatures below 16°K. The resultant susceptibility of each alloy is given with reasonable accuracy by an expression of the form $aT + b + (c/T)$, and the significance of each of these terms is discussed. A theoretical model, in which the number of nickel atoms possessing resultant magnetic moments is temperature-dependent and which fitted the earlier high-temperature data reasonably well, has been found inadequate for the new low-temperature results. A.

538.222

3448. A PRECISION PARAMAGNETIC RESONANCE SPECTROMETER. K.D.Bowers, R.A.Kamper and R.B.D.Knight.
J. sci. Instrum., Vol. 34, No. 2, 49-53 (Feb., 1957).

An instrument is described for the accurate comparison in the same magnetic field of the frequency of electronic magnetic resonance absorption, particularly in gaseous materials, with the frequency of proton resonance absorption. Details are given of (1) the production of a homogeneous magnetic field, which can be stabilized at any value between 1 and 11 kG; (2) the production and measurement of the radiofrequencies used for the observation of proton resonance in this field; (3) the supply and measurement of a stable microwave frequency in the region of 9000 to 10 000 Mc/s; (4) the sensitive detection of paramagnetic resonance absorption at this frequency using 115 kc/s magnetic field modulation. The precision of the measurements is about three parts per million; it is limited mainly by the homogeneity of the magnetic field, and the measurement of the proton resonance frequency. A.

538.222

3449. EXPERIMENTAL ARRANGEMENTS FOR THE MEASUREMENT OF PARAMAGNETIC RELAXATION AND RESONANCE, AND OF MAGNETIC NUCLEAR RESONANCE IN THE LOUVAIN LABORATORY. I. PARAMAGNETIC RELAXATION. A.van Itterbeek and L.van Gerven.
Meded. K. Vlaamse Acad. Wetensch., Vol. 17, No. 1, 1-22 (1955). In Dutch.

The theory of paramagnetic relaxation is briefly surveyed. A description is given of an apparatus to measure paramagnetic absorption with Gorter's calorimetric method. Measurements are executed in magnetic fields, perpendicular to the h.f. field at 90°K and 77°K. Paramagnetic absorption in $CrK(SO_4)_2.12\,H_2O$ and $Cu(NH_4)_2(SO_4)_2.6\,H_2O$ is measured at different frequencies and in constant fields up to 6300 Oe. The influence of the gas in the gas thermometer is studied. The increase of pressure in the thermometer is 10% more for hydrogen than for helium. This is probably due to the desorption of gas from the salt, due to heating by the magnetic absorption. The internal magnetic field of $CrK(SO_4)_2.12\,H_2O$ is found to be about 250 Oe and of $Cu(NH_4)_2(SO_4)_2.6\,H_2O$ 100 to 200 Oe. C.Turner

538.222

3450. SPIN–SPIN RELAXATION AT VERY LOW TEMPERATURES IN CHROMIC METHYLAMMONIUM ALUM. E.Ambler and R.P.Hudson.
Phys. Rev., Vol. 104, No. 6, 1500-5 (Dec. 15, 1956).

The absorption due to spin–spin relaxation in chromic methyl-

ammonium alum has been measured at frequencies from 0.1 to 10 Mc/s and at temperatures from 0.06° to 1°K. At 1°K the spin–spin relaxation time, τ_S, is found to be 4.2×10^{-10} sec and to be decreasing slowly with increasing temperature. Below 1°K, τ_S increase rapidly. The absorption of energy is found to be proportional to the square of the frequency, ν, at the higher temperatures, but varies less rapidly at lower temperatures, being proportional to $\nu^{1.83}$ at 0.06°K. The results are analysed in terms of Broer's theory of spin–spin relaxation, and, not surprisingly, the theory is found to need refinement in order to be applicable at temperatures where Curie's law is not obeyed. It is concluded that measurements of this type, which give essentially the same kind of information as is obtained from resonance line shapes, should be able to throw light upon the behaviour of substances near their antiferromagnetic transition points. A.

538.24 : 538.6

3451. FORGOTTEN MAGNETO-OPTICAL EFFECT. J.R.Lamarsh.
Amer. J. Phys., Vol. 25, No. 1, 17-18 (Jan., 1957).

An interesting magneto-optical effect discovered at the close of the last century has gone unnoticed. When an annealed soft iron rod is magnetized by a solenoid and then de-magnetized it can be re-magnetized by light, heat or mechanical shock. The experimental evidence for the phenomenon is reviewed, and a qualitative explanation is presented. New experiments are required to obtain a complete understanding of the effect, and such an undertaking is strongly urged. A.

538.24

3452. SATURATION MAGNETIZATION IN COPPER–NICKEL ALLOYS. S.A.Ahern and W.Sucksmith.
Proc. Phys. Soc. B., Vol. 69, Pt 10, 1050-2 (Oct., 1956).

Results of measurements of the ferromagnetic Curie point and the saturation moment of Cu–Ni alloys containing up to 34.3% Cu. The chemical analysis of the alloys is stated to 0.1%, and the saturation moments are claimed to be accurate to 2%. The results are discussed briefly in relation to earlier measurements and to their theoretical interpretation. A.E.De Barr

538.242

3453. GYROMAGNETIC RATIO OF COBALT. G.G.Scott.
Phys. Rev., Vol. 104, No. 6, 1497-8 (Dec. 15, 1956).

Magnetomechanical measurements were made on two cobalt rods in an attempt to find changes in the g' factor at low magnetic intensities. No such effect was found, g' being independent of the induced magnetic intensity down to the lowest values which could be measured. The results also indicate that cobalt samples of high purity would be required in order to obtain an accurate value of g' for this metal. A.

538.244.2 : 538.614

3454. MAGNETS FOR RESONANCE WORK FROM TRANSFORMERS. S.Broersma.
Amer. J. Phys., Vol. 24, No. 7, 500-2 (Oct., 1956).

With minor modifications, cutting and shaping one of the sides of the iron circuit, a core transformer can be made into a magnet. For example, one obtains a field strength of 6 kilogauss from such an electromagnet with a 1 in. pole separation and 1 in. pole diameter. Using hollow pole-pieces, it is possible to send a beam of microwaves through a paramagnetic sample placed between the poles inside a Dewar flask and to measure the microwave Faraday effect. The beam passes through the side walls of the oval-shaped flask. For 10 g of $MnSO_4 \cdot 4H_2O$ the absorption at the resonance point is 11, 26 and 30%; going through resonance the angle of rotation varies from plus to minus 1.9, 5.6 and 6.2 degrees for 290, 77 and 20°K, respectively. A.

538.245

3455. THEORY OF SPONTANEOUS MAGNETIZATION OF FERROMAGNETIC SEMICONDUCTORS IN THE LOW TEMPERATURE REGION. E.I.Kondorskiĭ, A.S.Pakhomov and T.Shiklosh.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 5, 931-4 (1956). In Russian.

A number of workers have studied the spontaneous magnetization of ferrites following the basic idea of sublattices due to Néel (Abstr. 3388/1948). At low temperatures these workers give formulae which differ among themselves. The present paper follows the method of secondary quantization in the form developed by Bogolyubov and Tyablikov (Lectures on quantum statistics, Kiev, 1949) and a formula for the spontaneous magnetization of ferrites is derived consisting of three terms. One term of the expression is numerical, whilst the other two tend to zero at absolute zero, one much more rapidly than the other. The net result at low temperatures is to give a "three-halves" law. C.R.S.Manders

538.245

3456. ANGLES BETWEEN PARTIAL MAGNETIZATIONS IN SPINEL FERRITES CONTAINING MANGANESE IONS OF MORE THAN ONE VALENCY. W.P.Osmond.
Phil. Mag. (Eighth Ser.), Vol. 1, 1147-56 (Dec., 1956).

In iron-deficient spinel ferrites containing manganese, but no other constituent of variable valency, all the manganese will not be divalent. Mn^{3+} ions tend to form strong directed semicovalent bonds in octahedral (B) sites but not in tetrahedral (A) sites. The reverse is true for Fe^{3+} ions. The antiparallel A–B indirect exchange interaction should thus be weaker when one interacting ion is Mn^{3+} than when both are Fe^{3+}. Any Mn^{3+} ions are likely to be coupled with parallel spins by double exchange with Mn^{2+} or Mn^{4+} ions in the same type of lattice site. The magnetic ions in either sublattice can then be considered as divided into two groups, one based on Mn^{3+} ions, and the other on Fe^{3+} ions, with different degrees of departure from antiparallelism of their net spins to the net magnetization of the other sublattice. The molecular field approximation as applied by other authors to single ions is extended to such groups of ions, with certain provisos as to the correct interpretation to be given to the mathematical symbols used for interaction coefficients and angles between spin directions. A.

538.245 : 548.74

3457. MAGNETIC STRUCTURES IN COPPER–MANGANESE ALLOYS. D.Meneghetti and S.S.Sidhu.
Phys. Rev., Vol. 105, No. 1, 130-5 (Jan. 1, 1957).

A neutron diffraction study of a series of substitutional solid solutions up to 85 atomic % manganese in copper has shown that at about 13 atomic % manganese, a broad intensity maximum appears in the region of (100) reflection of the face-centred cubic pattern of copper. A correlation of this maximum with the magnetic attraction of the specimens indicates that it is at least in part due to short-range magnetic order. Its intensity decreases at compositions greater than 50 atomic % manganese. Above 69 atomic % manganese an antiferromagnetic structure is observed and is interpreted as due to an antiferromagnetic coupling between manganese atoms as the manganese concentration becomes predominant. A.

538.245 : 539.32

ANTIFERROMAGNETISM OF Cr_2O_3. See Abstr. 2740

ELECTROMAGNETISM.

ELECTRODYNAMICS 538.3/.5

538.3

3458. DEVELOPMENT OF THE MAXWELL–LORENTZ EQUATIONS FROM SPECIAL RELATIVITY AND GAUSS'S LAW. D.H.Frisch and L.Wilets.
Amer. J. Phys., Vol. 24, No. 8, 574-9 (Nov., 1956).

Maxwell's equations and the Lorentz force law are developed by applying the transformations of special relativity to Gauss's law on the flux of the electric field, $E \cdot dS = 4\pi q_{enclosed}$, provided that electromagnetic signals are propagated with the speed of light, and that the electric force on a test charge is velocity-independent and does not depend on time derivatives of the source position of order higher than the acceleration. A.

538.3 : 530.12

3459. ON RELATIVISTIC ELECTRODYNAMICS IN ARBITRARY MEDIA. E.Schmutzer.
Ann. Phys. (Leipzig), Vol. 18, No. 3-4, 171-80 (1956). In German.

In the case of an anisotropic medium, the dielectric constant and the reciprocal permeability in the rest-frame are replaced by tensors which in general are non-symmetric and field-dependent. The electromagnetic equations are written in 4-tensor form, and the relation between inductions and intensities in a moving frame are considered. It is shown that the electromagnetic equations for the general medium considered may be derived from a variation principle.

R.A.Newing

538.3

3460. ON THE DETERMINATION OF THE ELECTROMAGNETIC FIELD IN THE INTERIOR OF A HOMOGENEOUS ISOTROPIC CONDUCTOR. II. A.Tonolo.
R.C. Accad. Naz. Lincei, Vol. 20, No. 5, 556-60 (May, 1956). In Italian.

Mathematical continuation of Pt I (Abstr. 547/1957).

538.3

3461. THE ASYMMETRY OF THE MAXWELL EQUATIONS. P.de Belatini.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 20, No. 4, 303-23 (Oct., 1955).

The author's triplicity, electricity-dielectricity-magnetism (Abstr. 7664/1955), is used to express the equation $-\text{curl}\,\vec{E} = d\vec{B}/dt$ in the form $-\text{curl}\,\vec{U} = \vec{F} + d\vec{B}/dt$, where $\vec{U}$ and $\vec{F}$ are dielectric and electric terms. The new equation is interpreted as a vector form of Kirchhoff's first law. The physical interpretation of the "electric intensity whirl" $\vec{F}$ is discussed at length and is said to give rise to a "spinning electric mode" in which there are closed dielectric lines of force. The mode has an associated "current whirl density" $\vec{Y}$, and a new resistivity is defined to be $\tau = F/Y$. R.A.Newing

538.3 : 532.5 : 530.12

ELECTRODYNAMICS OF FANTAPPIÈ'S RELATIVITY. See Abstr. 2957

538.311

3462. EXPRESSION, BY A LINE INTEGRAL, FOR THE SCALAR MAGNETIC POTENTIAL DUE TO A CURRENT IN A WIRE. E.Durand.
C.R. Acad. Sci. (Paris), Vol. 242, No. 1, 78-81 (Jan. 4, 1956). In French.

The expression for the potential at a point due to a circular current of magnitude I, $V = I\omega/4\pi$, is used and the solid angle ω is written as a surface integral, which is then converted into a line integral for a spherical polar coordinate system. The result is used for the case of a current in a circular loop and the solid angle is given finally in terms of Legendre integrals of the first and third kinds. A.E.Kay

538.551.26

3463. DEMONSTRATION OF ELECTRICAL TRANSIENTS. D.H.Rogers.
Amer. J. Phys., Vol. 25, No. 2, 64-7 (Feb., 1957).

A demonstration of electrical transients is described, intended for classes in elementary electricity, which yields a graphic illustration of the addition of the transient and steady-state terms in the solution of the equation for a ringing circuit under a.c. excitation. A.

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 532.5

3464. ON SOME SECOND-ORDER EFFECTS IN MAGNETO-HYDRODYNAMICS. II. R.Nardini.
R.C. Accad. Naz. Lincei, Vol. 20, No. 5, 591-6 (May, 1956). In Italian.

Continuing a previous investigation (Abstr. 549/1957) a method of successive approximations is used to investigate the effect of second-order terms on the particle velocity, condensation and magnetic intensities. The presence of the magnetic field adds a term proportional to $W(t - z/V) - W(t - z/c)$ to the longitudinal particle velocity in the case of a sound-type wave of finite amplitude, W being the magnetic energy density, and c and V the acoustic and hydromagnetic wave velocities. R.A.Newing

538.561

3465. ON THE OSCILLATIONS OF AN ELECTRON PLASMA IN A MAGNETIC FIELD. A.G.Sitenko and K.N.Stepanov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 642-51 (1956). In Russian.

The kinetic theory of the electron plasma oscillations in a constant magnetic field is considered. The plasma oscillations with frequencies which are a multiple of the gyrofrequency are investigated. The refraction indices of the ordinary, extraordinary and plasma waves propagated at an arbitrary angle θ with respect to the magnetic field are determined. It is shown that at frequencies which are multiples of the gyrofrequency the plasma wave is strongly damped if $\theta < \pi/2$. The plasma waves with these frequencies cannot be propagated if $\theta \cong \pi/2$. The "gap" width in the plasma oscillation frequency spectrum has been determined. A.

538.566

3466. MICHELSON'S INTERFEROMETER USING A MICROWAVE SOURCE. T.G.Bullen.
Amer. J. Phys., Vol. 24, No. 7, 525–6 (Oct., 1956).

Gives constructional details of an instrument which is of use in teaching physical optics. It is easy to assemble and allows the wavelength of the source to be determined to a good degree of accuracy with a minimum of adjustment. W.Bardsley

538.566

3467. BACK-SCATTERING FOR ARBITRARY ANGLES OF INCIDENCE OF A PLANE ELECTROMAGNETIC WAVE ON A PERFECTLY CONDUCTING SPHEROID WITH SMALL ECCENTRICITY. Y.Mushiake.
J. appl. Phys., Vol. 27, No. 12, 1549-56 (Dec., 1956).

The scattering is treated by a method of expanding the scattered field directly in a series of spherical vector wave-functions. An expression for the first-order solution of the back-scattered field is obtained for arbitrary angles of incidence of a plane wave. The numerical values of echo areas computed from the first-order expression are shown for various cases, and rough experimental results are also discussed. During this study some mathematical formulae involving the associated Legendre functions have been derived. A.

538.566 : 621.318.1 : 621.372.8

3468. WAVEGUIDE COMPONENTS WITH NON-RECIPROCAL PROPERTIES. II. THE BEHAVIOUR OF FERRITES IN WAVEGUIDES. J.Brown and P.J.B.Clarricoats.
Electronic Engng, Vol. 28, 376-9 (Sept., 1956).

For Pt I, see Abstr. 557 (1957). This article describes the behaviour of ferrites in waveguides and the operation of various waveguide components employing ferrites. Circular waveguides with axial ferrite rods, and ferrites in rectangular waveguide are discussed, and the components considered are: gyrator (in circular and in rectangular waveguide), isolator, and circulator. A.E.De Barr

538.566.2

3469. ABSORPTION OF ELECTROMAGNETIC WAVES IN WEAKLY IONIZED GASES (IONOSPHERIC AND LORENTZIAN PLASMAS). M.Lozzi, R.Jancel and T.Kahan.
Appl. sci. Res. B, Vol. 5, No. 1-4, 327-30 (1955). In French.

A general expression of the absorption coefficient is given. This is in terms of certain integrals which require assumptions about molecular interactions for their evaluation. It is intended to proceed to numerical solutions on the assumption that the interaction is that of rigid sheres, and also for a $1/r^5$ power law. H.Motz

538.566.2

3470. A PECULIAR FEATURE OF THE FIELD OF AN ELECTROMAGNETIC WAVE PROPAGATED IN AN INHOMOGENEOUS PLASMA. N.G.Denisov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 609-19 (1956). In Russian.

The effect of increase of the field in the region of a plasma in which the dielectric constant is zero has been investigated. The role of absorption has been elucidated. A connection between this effect and plasma resonance has been established. A.

MOLECULAR AND ATOMIC STRUCTURE

539.1

THEORY OF SOLID STATE 539.11

539.11

3471. SOLID STATE PHYSICS. ADVANCES IN RESEARCH AND APPLICATIONS. VOLUME 2. Edited by F.Seitz and D.Turnbull.
New York: Academic Press; London: Academic Books (1956).

Review in Nature (London), Vol. 178, 1139 (Nov. 24, 1956). For a review of Vol. 1 see Abstr. 6038 (1956).

539.11

3472. EFFECT OF ALLOYING ON THE ENERGY-LEVELS OF INNER ELECTRONIC SHELLS. J.H.O.Varley.
Nature (London), Vol. 178, 939-40 (Oct. 27, 1956).

The constancy of the X-ray emission edge for alloys is explained in terms of the change in both Fermi energy and K-level energy produced by charge transfer on alloying. E.H.Sondheimer

539.11

3473. LATTICE CONSTANTS AND BRILLOUIN ZONE OVERLAP IN DILUTE MAGNESIUM ALLOYS. F.W.von Batchelder and R.F.Raeuchle.
Phys. Rev., Vol. 105, No. 1, 59-61 (Jan. 1, 1957).

The lattice constants of primary solid solutions of indium, aluminium, and cadmium in magnesium have been determined as a function of composition. A sharp change in (c/a) has been found only for magnesium-indium. The linearity of the (c/a) v. concentration curve for magnesium-aluminium has suggested that electron zone overlap does not necessarily lead to axial ratio anomalies and that changes in short-range order may be needed to explain such anomalies. A.

539.11

3474. EFFECTIVE MASS THEORY IN SOLIDS FROM A MANY-PARTICLE STANDPOINT. W.Kohn.
Phys. Rev., Vol. 105, No. 2, 509-16 (Jan. 15, 1957).

Effective-mass equations for electrons and holes in solids are usually derived by means of the independent-particle model. It is shown in the present paper that for the case of an extra electron or a hole in an insulator, or semiconductor, moving under the action of a weak Coulomb field, an effective-mass equation

$$\left(-\frac{h^2}{2m^*}\nabla^2-\frac{qe}{\kappa r}\right)F = EF,$$

can be derived from some very general properties of the entire many-particle system (m^* = effective mass, q = external charge, κ = static dielectric constant). The effects of exchange and correlation are automatically included without approximation. It is suggested that the same type of result can be derived for the motion of electrons and holes in arbitrary slowly varying and weak electromagnetic fields. A.

539.11

3475. MOMENTUM DISTRIBUTION OF ELECTRONS IN SOLIDS. II. SOME GENERAL RESULTS WITH AN APPLICATION TO METALLIC LITHIUM. B.Donovan and N.H.March.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1249-60 (Dec., 1956).

For Pt I, see Abstr. 2633 (1954). An investigation is made of the general problem of calculating the momentum distribution of electrons in solids. As a preliminary illustration the Kronig–Penney one-dimensional model is considered and momentum eigenfuctions are obtained for the limiting case of a delta-function potential. The three-dimensional problem is then formulated and the methods are applied to metallic lithium. A procedure for calculating momentum eigenfunctions for conduction electrons is given for the case in which the wave-functions are of the simple form given by Seitz. The calculation of the momentum distribution function is then discussed in detail and finally the shape of the Compton profile in X-ray scattering is obtained. The results are in good agreement with previous calculations based on the Thomas–Fermi approximation but the predicted broadening of the Compton line is considerably less than that obtained in the experiments of Kappeler. The effect of using a more refined wave-function is investigated but it appears unlikely that the discrepancy can be resolved in this way. A.

MOLECULES 539.13

539.13

3476. THE ENERGY OF INTERACTION OF He^+ AND H. J.Ross and E.A.Mason.
Astrophys. J., Vol. 124, 485-7 (Sept., 1956).

A first order quantum-mechanical perturbation calculation gives results that may be represented approximately as $V(R) = -(1/R) + 5.202\exp(-1.437R)$, where R is the nuclear separation. R.A.Newing

539.13

3477. CALCULATION OF ION SCATTERING BY MOLECULES WITH A 4-12 POTENTIAL MODEL. V.W.Myers.
J. chem. Phys., Vol. 25, No. 6, 1284 (Dec., 1956).

Mason's improvement (Abstr. 2272/1956) of the method of Abstr. 5550/1955 is applied to this potential for scattering of H_2^+ by He and by H_2, with reasonable agreement with experiment. J.Hawgood

539.13

3478. SHORT RANGE INTERMOLECULAR FORCES. I. E.A.Mason and J.O.Hirschfelder.
J. chem. Phys., Vol. 26, No. 1, 173-82 (Jan., 1957).

A method is given for accurately approximating most of the integrals which occur in calculations of intermolecular forces. Two types of integrals arise; those between orbital pairs which are seperated by a considerable distance from each other, and those where the orbital pairs overlap. In the first case the orbital pairs are considered to be electrostatic charge distributions and their energy of interaction is given by a multipole expansion. From a practical standpoint it is necessary to consider only the first few terms (through quadrupoles) of such an expansion. When the orbital pairs overlap, the integral can be approximated by the Mulliken formula in terms of Coulombic type integrals which are then further approximated by the multipole expansion. The problem of calculating intermolecular forces is thereby reduced to the calculation of a number of classical electrostatic multipole interactions. The procedure can be applied to Coulombic as well as exchange forces. Examples are given for the interaction of two hydrogen atoms (in the triplet sigma state), first the repulsion energy alone, and then the combination of Coulombic and exchange energies showing the lack of additivity; the energy of repulsion between two helium atoms; and the energy of repulsion between a hydrogen and a helium atom. A.

539.13

3479. SOME MOLECULAR COLLISION INTEGRALS FOR POINT ATTRACTION AND REPULSION POTENTIALS. M.A.Eliason, D.E.Stogryn and J.O.Hirschfelder.
Proc. Nat. Acad. Sci. U.S.A., Vol. 42, No. 8, 546-59 (Aug., 1956).

Theoretical paper. If $\phi = d/r^\delta$ is the intermolecular energy of a pair of molecules interacting in a dilute gas, the expression for the collision integrals contains certain functions $A^{(l)}(\delta)$. Some values of the A are here determined for repulsive and attractive interaction potentials. The notion of the $A^{(l)}(\delta)$ is new, and, surprisingly, the collision integrals are finite. J.Jacobs

539.132 : 518.5

3480. AUTOMATIC FUNDAMENTAL CALCULATIONS OF MOLECULAR STRUCTURE. S.F.Boys, G.B.Cook, C.M.Reeves and I.Shavitt.
Nature (London), Vol. 178, 1207-9 (Dec. 1, 1956).

Brief description of calculations on BH, H_2O and H_3 in which not only arithmetical but also algebraic and formal mathematical operations were carried out automatically by EDSAC, and discussion of general usefulness of the method. The calculated binding energies and force constants of the three systems agree reasonably with experiment (when available). J.Hawgood

539.132

3481. ON THE BINDING ENERGY OF THE HELIUM HYDRIDE ION. A.C.Hurley.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 868-70 (Nov., 1956).

An intra-atomic correlation method (Abstr. 1493/1957) gives lower limits to the true value of the binding energy of the HeH^+ ion which are about 1 eV more accurate than the values obtained by orbital calculation. G.I.W.Llewelyn

539.132

3482. FERMI DIAD 10^00 AND 02^00 OF NITROUS OXIDE. K.Narahari Rao and H.H.Nielsen.
Canad. J. Phys., Vol. 34, No. 11, 1147-52 (Nov., 1956).

Measurement of the fine structure of the bands ν_1 and $2\nu_2^0$ of nitrous oxide had led to an evaluation of the centrifugal stretching constants of the Fermi diad 10^00 and 02^00. It was found that as compared to the value in the ground state, the change in the centrifugal stretching constant of the 02^00 level is much more than in the 10^00 level. This result has been discussed in relation to the theory of Nielsen, Amat, and Goldsmith (1956). The following revised values have been obtained for some of the molecular constants of $N_2{}^{14}O^{16}$:

$$\Delta_0 = G_0(10^00) - G(02^00) = 100.2 \pm 3\ cm^{-1}$$
$$K = 42.3 \pm 3\ cm^{-1} \text{ or } W = 29.9 \pm 2.0\ cm^{-1}$$
$$\alpha_1 = 1.99 \times 10^{-3}\ cm^{-1},\ \alpha_2 = -0.5_6 \times 10^{-3}\ cm^{-1}.$$ A.

539.132 : 535.343

3483. RYDBERG SPECTRUM OF BENZENE. A.D.Liehr and W.Moffitt.
J. chem. Phys., Vol. 25, No. 5, 1074 (Nov., 1956).

The intense unprimed nR-A series is assigned to excited orbitals of symmetry $a_{2u}(n^1E_{1u} - {}^1A_{1g})$, and the three primed series nR′,″,‴,⁗–A are attributed to e_{1u} or e_{2u} orbitals. In both cases one intense and two weak members are observed as expected, and the

fact that the separations within the triplets of the primed series are independent of deuteration is accounted for. The vibrational spectrum of the excited states is attributed to $C_6H_6^+$, and calculations suggest that for the 670 cm^{-1} progression the vibrational spacing corresponds to one quantum intervals of $\nu_{18}(e_{2g})$. G.Allen

539.132

3484. FERMI INTERACTION TERMS IN $C^{12}O_2^{16}$ AND $N_2^{14}O^{16}$. H.H.Nielsen and K.Narahari Rao.
J. chem. Phys., Vol. 25, No. 5, 1078 (Nov., 1956).

Experimental results (Abstr. 2282, 4558/1956) are analysed to give the separation for no perturbation Δ_0 and the Fermi interaction term K for the diad 10^00 and 02^00 in these molecules. The K values are of the same order, though the Δ_0 for N_2O is about ten times that for CO_2. J.Hawgood

539.132

3485. ENERGY LEVELS OF THE COAXIAL INTERNAL ROTATOR WITH RECTANGULAR POTENTIAL FUNCTION. J.O.Halford and G.L.Vidale.
J. chem. Phys., Vol. 25, No. 6, 1180-3 (Dec., 1956).

For the coaxial internal rotator with rectangular potential function and freely variable valley breadth at constant periodicity, conditions are specified for an infinite number of points at which the borders of consecutive bands of energy levels must be exactly degenerate. As the valley breadth is changed through a degeneracy, the level of one symmetry relative to the potential function moves from the upper to the lower band of energy levels, or vice versa. It follows that in the rotational region above the potential maximum the levels at the band limits can repeatedly cross and re-cross when the potential maximum is increased with all other factors constant. Similar behaviour will presumably occur with other potential functions. A.

539.132

3486. OUT-OF-PLANE CH VIBRATIONS OF BENZENE DERIVATIVES. T.Shimanouchi, Y.Kakiuti and I.Gamo.
J. chem. Phys., Vol. 25, No. 6, 1245-51 (Dec., 1956).

The normal coordinate treatment is made of the infrared active out-of-plane CH vibrations for various benzene derivatives. Frequencies calculated with the use of the out-of-plane force constants for benzene are in good agreement with the observed values. Intensities of these bands are also dealt with. The result confirms that the CH bond has the sign of polarity opposite to that of the carbon–halogen bonds. A.

539.132

3487. OUT-OF-PLANE FORCE CONSTANTS OF BENZENE. Y.Kakiuti and T.Shimanouchi.
J. chem. Phys., Vol. 25, No. 6, 1252-4 (Dec., 1956).

The out-of-plane force constants were calculated from the out-of-plane frequencies of C_6H_6, C_6D_6, and sym.-$C_6H_3D_3$ molecules with the use of the least square method. The 45 frequencies of C_6H_6, C_6D_6, sym.-$C_6H_3D_3$, p-$C_6H_4D_2$, p-$C_6H_2D_4$, and C_6H_5D molecules calculated from five force constants obtained are in good agreement with the observed, with the maximum and the mean deviations of 2.8 and 1.3%, respectively. A.

539.132

3488. VIBRATIONAL INTENSITIES. VI. ETHYLENE AND ITS DEUTEROISOTOPES. R.C.Golike, I.M.Mills, W.B.Person and B.Crawford,Jr.
J. chem. Phys., Vol. 25, No. 6, 1266-75 (Dec., 1956).

For Pt V, see Abstr. 2941 (1955). Absolute intensity measurements have been made on the fundamental vibrations of ethylene and four of its deuteroisotopes. The bands were pressure broadened with nitrogen at 50 atm, and the intensities were determined by the method of Wilson and Wells except that the observed optical density was integrated against $\log\nu$ rather than ν. Normal coordinates have been calculated, and the intensities have been interpreted in terms of quantities $(\partial p/\partial S_j)$ giving the change in dipole moment with respect to each internal symmetry coordinate. Data from the different isotopic species have been used to eliminate ambiguities in the interpretation. Effective bond moments are calculated for each symmetry coordinate. A.

539.132 : 532.73

3489. EFFECT OF PRESSURE ON THE O–H STRETCHING FREQUENCY OF BUTANOL IN NON-POLAR SOLVENTS. M.L.Josien, J.Lascombe and N.Fuson.
J. chem. Phys., Vol. 25, No. 6, 1291-2 (Dec., 1956).

Comments on work of Fishman and Drickamer (Abstr. 4321/1956), who found that the frequency shift $\Delta\nu/\nu_0$ due to pressure was proportional to the square of the density, and could not be accounted for by the Kirkwood–Bauer–Magat relation (Abstr. 9457/1954). It is asserted that the results are better fitted by $\Delta\nu/\nu_0 \propto B/(1+B)$ where B is proportional to the density, and can be adequately accounted for by the K.B.M. relation. J.Hawgood

539.132

3490. THEORETICAL INVESTIGATION OF VIBRATIONAL FREQUENCY DISTRIBUTIONS FOR MOLECULAR CRYSTALS HAVING THE CYANOGEN IODIDE STRUCTURE. T.H.Walnut.
J. chem. Phys., Vol. 26, No. 1, 10-18 (Jan., 1957).

Frequency distributions are determined for a molecular stretching vibration band in a cyanogen iodide lattice. The eigenfrequencies of the vibrational problem are calculated with first order perturbation theory. Distributions for possible reasonable sets of coupling constants are determined. The behaviour of the distributions near external values are computed by the method of van Hove. The behaviour of the distributions between extremal values is obtained by interpolation based on a qualitative examination of the eigenfrequencies as a function of wave-number vector. A.

539.132

3491. THEORY OF INTERNAL OVER-ALL ROTATIONAL INTERACTIONS. IV. STARK EFFECT IN NONRIGID INTERNAL ROTORS. D.Kivelson.
J. chem. Phys., Vol. 26, No. 1, 215-17 (Jan., 1957).

For Pt III see Abstr. 3883 (1956). When a uniform electric field is applied to a nonrigid internal rotor, the "Stark pattern" of the energy levels is dependent upon the torsional motion. This dependence enters as a centrifugal distortion interaction and by means of the so-called "repulsive effect" of the potential barrier to internal rotation. These effects are small but observable and require that appropriate corrections be made in order to obtain an accurate and meaningful dipole moment from Stark effect measurements. The theory of the Stark effect in vibrating internal rotors is formulated, with particular emphasis on its application to a molecule of C_{3v} symmetry such as CH_3SiH_3. Krongelb and Strandberg have observed this effect in CH_3SiH_3. A.

539.132

3492. ELECTRONIC STRUCTURES AND ELECTRONIC SPECTRA OF p-QUINOID COMPOUNDS. M.Okuda.
J. chem. Phys., Vol. 25, No. 5, 1083-4 (Nov., 1956).

The second of the three bands in p-benzoquinone (and NH- and CH_2-substituted molecules) is assigned as the forbidden $\pi-\pi$ transition ($^1A_{1g} - {}^1B_{1g}$), with the aid of semi-empirical ASMO-CI calculations. J.Hawgood

539.132

3493. IMPORTANCE OF DOUBLY EXCITED CONFIGURATIONS IN THE INTERPRETATION OF ELECTRONIC SPECTRA. J.N.Murrell and K.L.McEwen.
J. chem. Phys., Vol. 25, No. 6, 1143-9 (Dec., 1956).

An investigation has been carried out to determine the importance of doubly excited configurations in calculating the energies of the electronic states of an aromatic hydrocarbon. It is found that the calculated low energy states of benzene are largely unaffected by consideration of doubly excited states, except for the appearance of an E_{2g} state with energy comparable to that of the E_{1u} states. In addition, inductive and mesomeric shifts in the lowest energy (α) transition have been calculated for all the distinct positions of substitution in benzene, in terms of two parameters which depend on the substituent. It is seen that the inclusion of doubly excited states in the calculation is necessary in order to predict these effects reliably. A.

539.132

3494. METHOD OF MOLECULAR FIELDS. T.M.Dunn.
Nature (London), Vol. 178, 1108-9 (Nov. 17, 1956).

The crystal field theory of splitting of the electronic levels of an ion in a crystal, subject to the electric fields of the other ions, has been adapted to the study of atoms incorporated in molecules, in particular acetylene and ethylene. The attraction of the electrons of the selected atom to neighbouring atoms in the molecule is simulated by positive charges at the positions of these atoms. The Stark splitting of the free atom levels in the resultant field is then analysed. A number of results in the theory of molecules are thus made easily understandable, e.g. the success of the approximation which treats π and σ electrons independently. Application has also been made to the states of the ferricyanide complex. A.B.Lidiard

539.132

3495. ELECTRONIC SPECTRUM OF TRAPPED ETHANOL RADICALS. M.C.R.Symons and M.Townsend.
J. chem. Phys., Vol. 25, No. 6, 1299 (Dec., 1956).

Photochemically active compounds dissolved in ethanol and

studied at 77°K (glassy state) show violet coloration and become paramagnetic on irradiation. The latter is attributed to $(CH_3)_3CO$ radicals while coloration is associated with the CH_3CHOH radical. This method provides a useful method of producing radicals by trapping in a glassy medium and is complimentary to direct photolytic production. G.F.J.Garlick

539.132

3496. HYPERFINE STRUCTURE IN PARAMAGNETIC RESONANCE ABSORPTION SPECTRA. H.S.Jarrett.
J. chem. Phys., Vol. 25, No. 6, 1289-90 (Dec., 1956).

A theoretical calculation of configuration interaction for a CH section of an aromatic molecule free radical indicates a hydrogen fine-structure coupling constant of 28 gauss for unit unpaired electron density in the π electrons at the CH position in agreement with electron resonance experiments. D.H.Whiffen

539.132

3497. PROTON MAGNETIC RESONANCE IN POLYISOPRENE, POLYCHLOROPRENE AND POLYISOBUTYLENE. H.Kusumoto.
J. Phys. Soc. Japan, Vol. 11, No. 9, 1015-16 (Sept., 1956).

539.132

3498. ANOMALOUS LINE BROADENING OF PARAMAGNETIC RESONANCE LINES IN $Cu(NH_3)_4 SO_4H_2O$ AT LIQUID HELIUM TEMPERATURES. M.Date.

539.132

3499. LONG RANGE NUCLEAR INTERACTION IN PARAMAGNETIC RESONANCE. J.E.Bennett and D.J.E.Ingram.
Phil. Mag. (Eighth Ser.), Vol. 1, 970-3 (Oct., 1956).

Differences in the paramagnetic resonance spectra between Cu tetraphenyl porphin with 4 hyperfine lines and its tetra-para-chlor derivative with at least 9 lines is attributed to coupling with the Cl atoms even though these are 7 atoms distant from the Cu. D.H.Whiffen

539.132

3500. PARAMAGNETIC RESONANCE OF FREE RADICALS AT MILLIMETER WAVE FREQUENCIES. A.van Roggen, L.van Roggen and W.Gordy.
Phys. Rev., Vol. 105, No. 1, 50-5 (Jan. 1, 1956).

Paramagnetic resonance experiments have been made at 36 kMc/s and at 75 kMc/s on single crystals and on solid and liquid solutions of the free radicals: diphenyl picryl hydrazyl (DPPH), p-anisyl nitrogen oxide, and 2-(phenyl nitrogen oxide)- 2-methyl pentane-4-one-oxime-N-phenyl ether. The measurements indicate fields axially symmetric about the paramagnetic element in the first two, with $g_{11} = 3.0035$, $g_\perp = 2.0043$ for the first and $g_{11} = 2.0095$, $g_\perp = 2.0035$ for the second. The third radical has a lower symmetry with $g_x = 2.0042$, $g_y = 2.0064$ and $g_z = 2.0083$ along the principal axes of susceptibility. The hyperfine structure of DPPH in dilute solution (earlier observed by others) consists of five components, arising from interactions with the two N^{14} nuclei of the N^{14} group. The other two radicals of the present study were found to have in dilute liquid solution a triplet hyperfine structure arising from interaction with a single N^{14} nucleus. This structure is interpreted as indicating that the odd electron is localized mainly on an $-N{=}O$ group in each radical. The anisotropies in the g factors are believed to arise mainly from a residual spin–orbit coupling. A sensitive millimetre-wave magnetic-resonance spectrometer employing superheterodyne detection with a crystal multiplier as the beat frequency oscillator is described. A.

539.132 : 541.123

3501. NUCLEAR MAGNETIC N^{14} RESONANCE SPECTRA, MOLECULAR STRUCTURES, AND EXCHANGE REACTIONS IN THE SYSTEM N_2O_5–NO_2^+–NO_3^-–H_2O. R.A.Ogg,Jr and J.D.Ray.
J. chem. Phys., Vol. 25, No. 6, 1285-6 (Dec., 1956).

The N n.m.r. spectra of N_2O_5, NO_2^+, HNO_3, and NO_3^- have been measured and the chemical shifts determined. Solutions of N_2O_5 in HNO_3 show only one line indicating rapid exchange between the species NO_2^+, HNO_3 and NO_3^- which are known to be present. D.H.Whiffen

539.132

3502. NUCLEAR QUADRUPOLE RESONANCES OF Cl^{35} AND Br^{79} IN SOME HETEROCYCLIC COMPOUNDS. S.L.Segel, R.G.Barnes and P.J.Bray.
J. chem. Phys., Vol. 25, No. 6, 1286-7 (Dec., 1956).

539.132

3503. INFLUENCE OF THE SOLVENT ON THE CHEMICAL SHIFTS OF MONO-SUBSTITUTED BENZENES. P.L.Corio and B.P.Dailey.
J. chem. Phys., Vol. 25, No. 6, 1291 (Dec., 1956).

Reports experiments on these shifts in acetone, acetonitrile, CS_2, CCl_4 and cyclohexane. Shifts are independent of concentration over a wide range for cyclohexane, and are linear functions of volume concentration in the other solvents. The relative shifts extrapolated to infinite dilution are independent of solvent. J.Hawgood

539.132

3504. SIMPLE MOLECULAR ORBITAL TREATMENT OF CONJUGATION IN CHLOROBENZENE. J.A.Howe and J.H.Goldstein.
J. chem. Phys., Vol. 26, No. 1, 7-9 (Jan., 1957).

Simple molecular orbital theory, with inclusion of overlap, has been used to calculate the electron distribution and energy levels in chlorobenzene. Spectroscopic parameters were used, supplemented by the value of β_{CCl} previously obtained from quadrupole coupling data for vinyl chloride. Resonance dipole moments were also calculated for chlorobenzene and vinyl chloride. The results are in reasonable agreement with the observed dipole moment decreases and ionization potential shifts, assuming these to be chiefly brought about by conjugation. A.

539.132

3505. COMPARATIVE CALCULATIONS OF LCAO-MOs OF THE ALLYL RADICAL. J.Higuchi.
J. chem. Phys., Vol. 26, No. 1, 151-6 (Jan., 1957).

Comparative calculations are made for the π-electron system, the LCAO-MOs obtained by various methods being discussed from the point of view of form, charge distribution and energy. For reference, the results using both the MO method with configuration interaction (CI) and the valence-bond method are given. A.

539.132

3506. THE ELECTRONIC STRUCTURE AND SPECTRA OF SOME NITROGEN HETEROBENZENES. R.McWeeny and T.E.Peacock.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 41-50 (Jan., 1957).

The π-electron charge distributions and spectra are calculated for some nitrogen heterobenzenes, using self-consistent molecular orbital theory with configuration interaction. A single parameter is introduced to account for the difference in electron affinity between nitrogen and carbon atoms in the molecular framework. The assumption that this parameter is insensitive to changes in environment of the nitrogen atom is found to be satisfactory. There is a close (though superficial) resemblance between the present approach and that originally suggested by Hückel, elaboration being necessary mainly in discussion of spectra. A.

539.132

3507. CURVE CROSSING AND ORTHOGONALITY OF MOLECULAR ORBITALS. A.Dalgarno and N.Lynn.
Proc. Phys. Soc. A, Vol. 70, Pt 3, 176-82 (March, 1957).

The approximate representation of states whose potential energy curves cross (or nearly cross) is discussed quantitatively, by comparing the energies and transition integrals of the $2s\sigma$ and $3d\sigma$ states of HeH^{2+} calculated using various approximate molecular orbitals with the exact values. It is concluded that, whilst the usual methods of taking mixing with neighbouring states into account may lead to accurate values of the energies provided orthogonality is imposed, the oscillator strengths may be seriously in error, especially if they are associated with weak transitions. A.

539.133

3508. QUADRUPOLE MOMENT OF CARBON DIOXIDE. W.C.Hamilton.
J. chem. Phys., Vol. 25, No. 6, 1283 (Dec., 1956).

Calculation from Mulligan's SCF-LCAO wave-function (Abstr. 4587/1951) gives $q = 3.56 \times 10^{-16}$ cm^2. J.Hawgood

539.133

3509. STRUCTURAL INVESTIGATION OF $SnBr_4$ BY MEANS OF NUCLEAR QUADRUPOLE RESONANCE. K.Shimomura.
J. chem. Phys., Vol. 25, No. 6, 1298-9 (Dec., 1956).

The quadrupole resonance spectrum and its Zeeman effect for a single crystal of $SnBr_4$ show the crystal to be monoclinic and fix the orientation of the $SnBr_4$ tetrahedra with respect to the crystal axes. D.H.Whiffen

539.133

3510. MICROWAVE DETERMINATION OF THE STRUCTURE OF FLUOROBENZENE. B.Bak, D.Christensen, L.Hansen-Nygaard and E.Tannenbaum.
J. chem. Phys., Vol. 26, No. 1, 134-7 (Jan., 1957).

3D-, 4D-, and 2, 4, 6 D_3-fluorobenzene have been prepared. Their microwave spectra have been recorded and analysed. Values of their rotational constants together with known values of the rotational constants of ordinary fluorobenzene do not suffice for an unambiguous calculation of the 11 geometrical parameters of the molecule but by assistance from valence theory a small number of fairly probable models may be pointed out. A.

539.133 : 535.343

STRUCTURE OF THE HEXAMETHYL BENZENE MOLECULE.
See Abstr. 3140

539.133

3511. STATISTICS OF IMPERFECTLY FLEXIBLE MOLECULAR CHAINS. R.A.Sack.
J. chem. Phys., Vol. 25, No. 5, 1087-8 (Nov., 1956).

The results of calculations, using the method of Markoff chains, of (a) the photoelastic constants for identical links with fixed valence angle and hindered rotation, and (b) the mean-square length of a long chain of identical links with fixed valence angle and inherent twist, are given. These differ from the results of other authors (e.g. Abstr. 6123/1950). F.Ansbacher

539.133

3512. CONFIGURATION OF A POLYELECTROLYTE CHAIN IN SOLUTION. I.M.Krieger.
J. chem. Phys., Vol. 26, No. 1, 1-4 (Jan., 1957).

Starting with the Gibbs–Boltzmann relation between the probability of a configuration and its energy, an expression is derived for the probability of the configuration of a random chain having central interactions among its groups. By an approximate integration method suggested by Debye, a distribution function is derived for the vector between the chain ends. The result is applied to find the distribution and the mean square end-to-end distance of a polyelectrolyte ion. A.

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1

3513. ANGULAR MOMENTUM COUPLING AND THE INTER-NUCLEON INTERACTION IN THE CALCIUM ISOTOPES. J.B.French and B.J.Raz.
Phys. Rev., Vol. 104, No. 5, 1411-23 (Dec. 1, 1956).

A partial analysis is made of the results of the Massachusetts Institute of Technology Van de Graaff group on (d,p) reactions leading to the levels of Ca^{41}, Ca^{43} and Ca^{45}. The results demonstrate that the coupling scheme is rather close to the jj limit; more precisely they give small values for the amplitudes of certain minor components of the wave-functions for low-lying odd-parity states (e.g., the $(f_{7/2})^2_0\, p_{3/2}$ component of the lowest $J = 3/2^-$ level in Ca^{43}). The amplitudes determined in this way are used to deduce some features of the effective internucleon interaction. It turns out that the (d,p) amplitudes for the low-lying "multi-particle" states are essentially proportional to a matrix element which vanishes identically for any spin-dependent nucleon–nucleon interaction (of either $\sigma_2\cdot\sigma_2$, tensor or vector type) and thus one obtains directly an approximate range v. depth relationship for the spin-independent interaction. Finally, an approximate spin-dependent central interaction is determined by considering the level structures. A fairly satisfactory interaction between identical nucleons is found to be $H_{12} \cong -3[3-\sigma_1\cdot\sigma_2]\exp(-r^2/r_0^2)$ MeV with $r_0 \sim 2.7 \times 10^{-13}$ cm. The general features of the results are similar to those of Levinson and Ford, who consider level structures and magnetic moments, but the exchange nature of the interaction is different. A.

539.152.1

3514. MOMENTS OF INERTIA OF ROTATING NUCLEI. A.Bohr and B.Mottelson.
K. Danske Vidensk. Selsk., mat.-fys. Medd., Vol. 30, Paper 1, 24 pp. (1955).

Moments of inertia of rotating nuclei are analysed in terms of the motions of the individual nucleons. The kinetic energy of rotation is obtained by considering the motion of the nucleons in a rotating self-consistent field. For independent particle motion the moments are approximately those corresponding to rigid rotation. Correlations arising from residual interactions modify this result. The absolute value of the moments depends inversely on the strength of the residual interactions, and the moments corresponding to irrotational flow are only approached when the interactions become comparable to the effect of the average field. The observed moments indicate a strength of interaction about three times smaller than this strong interaction limit. P.T.Matthews

539.152.1

3515. ON THE POTENTIAL COLLECTIVE FLOW OF A ROTATING NUCLEUS WITH NON-ELLIPSOIDAL BOUNDARY. T.Gustafson.
K. Danske Vidensk. Selsk., mat.-fys. Medd., Vol. 30, Paper 5, 15 pp. (1955).

It is shown that the moment of inertia and quadrupole moment are sensitive to relatively small deviations from ellipsoidal shape of the nuclear boundaries. The results indicate that the model cannot account for the observed ratio of I/Q^2, and suggest significant departures of the collective motion from potential flow. P.T.Matthews

539.152.1

3516. ON THE COLLECTIVE DESCRIPTION OF NUCLEAR SURFACE OSCILLATION. T.Tamura.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 713-35 (Oct., 1956).

A general method for a collective description of a many-particle system, which was introduced by Miyazima and the present author and applied to the case of weak-coupling surface oscillation of the atomic nuclei, is extended here to the case of strong coupling, and the results are compared with those of other authors. A.

539.152.1

3517. THE NUCLEAR SURFACE. T.H.R.Skyrme.
Phil. Mag. (Eighth Ser.), Vol. 1, 1043-54 (Nov., 1956).

The basic ideas of Brueckner's self-consistent nuclear model are applied in a simplified, approximate form to the case of a finite nucleus. It is shown that it is possible to reconcile the observed values of surface energy and surface thickness, to explain the greater extension of the nuclear potential compared with the charge distribution, and also to fit the well-depth of the optical model for nucleon scattering. A.

539.152.1

3518. ZERO-ENERGY SCATTERING OF NEUTRONS BY OPTICAL MODELS. H.Amster.
Phys. Rev., Vol. 104, No. 6, 1606-11 (Dec. 15, 1956).

If the imaginary part of the complex square-well potential is adjusted to produce the correct-sized giant resonances in the total cross-sections of light nuclei, it is found to be too large to do the same for heavy nuclei and too small throughout most of the range of mass numbers to produce a suitable zero-energy strength function. Damping of giant resonances from optical potentials can generally be correlated with that of a zero-energy scattering amplitude, and the square well defects mentioned can all be studied with analytic simplicity at zero energy. When total cross-section data matching is performed for a square-well or a diffuse-edged potential, the imaginary part will be much less dependent on mass number if it is concentrated into a surface layer. However, once the parameters of any reasonable spherically symmetric potential have been determined from matching total cross-sections, a general relationship prohibits complete experimental agreement with the zero energy strength function. For certain potentials, disregarding the data for those nuclei known to be distorted does result in excellent agreement. A.

539.152.1

3519. APPROXIMATE ANALYTICAL WAVE FUNCTIONS FOR THE NUCLEAR INDEPENDENT PARTICLE MODEL. A.E.S.Green.
Phys. Rev., Vol. 104, No. 6, 1617-27 (Dec. 15, 1956).

The wave-functions, normalization constants, and certain important diagonal matrix elements have been calculated for the diffuse boundary potentials previously described. By taking advantage of the variety of well parameter combinations which give rise to the dimensionless potentials and by utilizing a simple perturbation method, one may extend the usefulness of these wave-functions to a large variety of potentials, and it should be possible to generate approximate independent-particle-model wave-functions for any proton or neutron state in any nuclear species with $A > 10$. Relative spin-orbit energy coefficients are calculated for a Thomas-type energy. The requirement that large energy discontinuities exist at the magic numbers N = 20, 28, 50, 82 and 126 restricts the spin-orbit term to be about 45 times the Thomas expression. The radii of neutron and proton orbitals are calculated, the latter being obtained after consideration is given to an attractive proton potential which is needed to account for the general trends of proton binding energies. Radii of neutron and proton distributions are also calculated. It is found that the equivalent uniform radii are $R_n = 1.30A^{1/3}$ and $R_p = 1.24A^{1/3}$ (in units of 10^{-13} cm). These are to be compared with an equivalent nuclear force radius $R_W = 1.38A^{1/3}$. The attractive nuclear anomaly leads one to expect a thin (0-0.4) neutron membrane around nuclei. A.

539.152.1

3520. NUCLEON DENSITIES IN A DIFFUSE-BOUNDARY INDEPENDENT-PARTICLE MODEL. A.E.S.Green, K.Lee and R.J.Berkley.
Phys. Rev., Vol. 104, No. 6, 1625-9 (Dec. 15, 1956).

The approximate wave-functions developed in the preceding abstract are applied to a survey of the proton and nucleon densities. The proton densities in six representative nuclei (each assumed to be spherically symmetrical) are calculated and compared with densities inferred from the systematics of the Stanford electron scattering experiments. Apart from a small systematic discrepancy in radii which may readily be removed by a slight readjustment of potential parameters, the theoretical and experimentally inferred proton densities are in general conformity. The theoretical densities, however, display a fine structure not present in the smoothed densities which have been used in interpreting the electron scattering experiments. The total theoretical nucleon densities also show a similar but less pronounced fine structure. In the six cases studied, it is found that the nuclear potentials extend significantly beyond the total nucleon densities. A discussion of the possible physical significance of the density-potential differences is given. A.

539.152.1 : 539.166.2

DE-EXCITATION OF N^{14}. See Abstr. 2606

539.152.1

3521. ANGULAR MOMENTUM COUPLING IN THE NUCLEAR p SHELL. J.B.French and A.Fujii.
Phys. Rev., Vol. 105, No. 2, 652–7 (Jan. 15, 1957).

Certain experimental results involving the nuclei A = 6–10 are compared with the predictions of the simple spin–orbit coupling model for p-shell nuclei in order to investigate the validity of this model and in particular to consider the significance of nucleon reduced widths as determined by deuteron reactions. A.

539.152.1

3522. TENSOR COUPLING AND THE VECTOR SHELL MODEL. A.M.Feingold.
Phys. Rev., Vol. 105, No. 3, 944-9 (Feb. 1, 1957).

Because of the large tensor force contribution to the nuclear binding energy, which results in a situation of near degeneracy for the low-lying states, the tensor force may produce a large mixing of the low states even in the absence of tensor matrix elements between them. The type of coupling among the low states resulting from this near degeneracy is investigated by perturbation theory; the high-lying states, which are considered largely responsible for the effects of the tensor force, are eliminated by applying closure. An intermediate-coupling model for the low states emerges which is very similar to the customary one based on a vector force in that the effective nuclear potential for the low states is shown to consist of a central two-body force (with a spin-dependence different from that of the elementary two-body central force), plus a strong vector force, plus a tensor force which is probably weaker than the elementary two-body tensor force. The effective vector force is principally a three-body force, and hence may be expected to show a quite different "hole"-particle relationship than the one- or two-body vector forces usually assumed in the shell model. Because of the neglect in the wave-function of the high-lying states which are mixed in directly by the tensor force, the model is expected to be valid for light nuclei only. The β-decay of B^{12} is discussed briefly, and is shown to be compatible with the tensor force as the sole spin–orbit force in the elementary two-body interaction. A.

539.152.1

3523. ENERGIES OF NUCLEI WITH DIFFERENT PROTON AND NEUTRON SHELLS. S.Goldstein and I.Talmi.
Phys. Rev., Vol. 105, No. 3, 995-1002 (Feb. 1, 1957).

Analysis of energies of nuclei in which protons and neutrons occupy different unfilled shells is made on the basis of the shell model. Good agreement of the calculated and experimental energies is obtained in the $s_{1/2}d_{3/2}$ and the $d_{3/2}f_{7/2}$ regions. Parameters characterizing the nuclear interaction were determined. When these are used in the case of K^{42} the right spin is obtained for the ground state. A.

539.152.1

3524. EXPANSION OF SINGLE-PARTICLE WAVE-FUNCTIONS INTO FUNCTIONS OF RELATIVE MOTION OF NUCLEONS. A.I.Baz'.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 831-6 (1956). In Russian.

At low energies of the relative motion, identical nucleons interact only if their relative orbital moment is zero. One may thus assume that a nucleon in the nucleus does not interact with all the remaining nucleons but only with those three which are in the S-state with respect to the given nucleon. These considerations lead to a picture which in many respects resembles the α-particle nuclear model. The shell model wave-functions were investigated from this viewpoint and some common properties of the shell and the α-particle nuclear properties were found. Some regularities relating to the binding energies of light nuclei are discussed. A.

539.152.1

3525. SEPARABLE NONLOCAL POTENTIAL AND NUCLEAR SATURATION. M.K.Sundaresan.
Phys. Rev., Vol. 105, No. 3, 1075–6 (Feb. 1, 1957).

The separable nonlocal potential of Yamaguchi, neglecting tensor force, has been used to calculate the binding energy per particle for an infinite nucleus, including the effects of the exclusion principle. It is found that the S–state separable potential does not lead to sufficient binding energy for a nucleus when surface effects are not taken into account. A.

539.152.1

3526. BINDING STATES OF INDIVIDUAL NUCLEONS IN STRONGLY DEFORMED NUCLEI. S.G.Nilsson.
K. Danske Vidensk. Selsk., mat-fys. Medd., Vol. 29, Paper 16, 68 pp. (1955).

Single-particle eigenvalues and eigenfunctions are computed for an ellipsoidal oscillator potential and a spin–orbit term. Expressions for the decoupling factor in rotational spectra, the magnetic moment, and the electromagnetic transition probabilities are given. P.T.Matthews

539.152.1

3527. DIRECT INTERACTION IN NEUTRON INELASTIC SCATTERING. J.T.Lamarsh and H.Feshbach.
Phys. Rev., Vol. 104, No. 6, 1633-9 (Dec. 15, 1956).

The direct interaction contribution to the cross-section for the inelastic scattering of neutrons leading to the excitation of a single particle of the target nucleus is derived by using the method of distorted waves. The interaction potential between the incident neutron and target nucleon is taken to be a three-dimensional delta function, and the incident and emergent neutrons are assumed to move in the complex potential of the "cloudy crystal ball" model. The wave-functions for the target nucleons are described in terms of the single-particle model. The theory is applied to the excitation of the first level in C^{12}. The angular distribution of the emergent neutrons is forward-peaked. The magnitude of the cross-section is small, however, and the effect will most easily be observed at neutron energies which lie between the levels of the compound nucleus. A.

539.152.1

3528. QUANTUM CALCULATION OF COULOMB EXCITATION. M1 AND M1-E2 MIXED TRANSITIONS AND CLASSICAL APPROXIMATION. L.C.Biedenharn and R.M.Thaler.
Phys. Rev., Vol. 104, No. 6, 1643-51 (Dec. 15, 1956)

Formulae are derived for magnetic-dipole Coulomb excitation, including spin effects. Numerical results are presented graphically. The mixed M1-E2 transitions are similarly discussed, and the simple pure-mixed analysis is shown to apply except for anomalous cases of slight interest. A.

539.152.1

3529. FIRST EXCITED STATE OF B^{11}: POSSIBILITY OF SPIN-FLIP STRIPPING. D.H.Wilkinson.
Phys. Rev., Vol. 105, No. 2, 666-71 (Jan. 15, 1957).

The first excited state of B^{11} at 2.14 MeV emits gamma-rays which have an isotropic distribution when excited over a wide range of energy in the reaction $B^{11}(p,p')B^{11*}$ and an isotropic correlation in the reaction $B^{10}(d,p)B^{11*}$. The natural assumption is therefore that the state is of spin 1/2 as is suggested by the shell model. This assignment is supported by certain gamma-ray studies in the reaction $Li^7(\alpha,\gamma)B^{11}$. However, in both the reaction $B^{10}(d,n)C^{11}$ and the mirror reaction $B^{10}(d,n)C^{11}$ leading to this level or its mirror level in C^{11}, an $l = 1$ stripping pattern is found, suggesting $3/2 \leq J \leq 9/2$. The observed isotropies could be given by emission from a state of 3/2– to the 3/2– ground state if the by a Doppler shift method using $B^{11}(p,p')B^{11}$ that the lifetime of the first excited state is less than 4×10^{-14} sec. It is shown that this limit is inconsistent with E2 sum rules and therefore that the transition is chiefly M1 and that the spin of the level must be 1/2–. This is consistent with the stripping result only if it is possible for the departing nucleon in such a reaction to flip its intrinsic spin and so transmit a further unit of angular momentum to the nucleus. A.

539.152.1 : 539.172.13

3530. POSSIBILITY OF A 3.41 MeV LEVEL IN C^{13}. J.Catalá, E.Villar and A.Bonet.
An. Real Soc. Espan. Fís. Quím., Vol. 52(A), No. 11-12, 251-8 (Nov.-Dec., 1956). In Spanish.

Acetylene was bombarded with 19.17 MeV deuterons and the protons emitted in the reaction $C^{12}(d,p)C^{13}$ studied by a photographic method. The range distribution presented four peaks, of which the one corresponding to a 3.41 MeV level of C^{13} is reported for the first time. L.Pincherle

539.152.1 : 539.172.13

3531. THE POSITION OF THE SECOND EXCITED LEVEL IN C^{12}. K.Ahnlund.
Ark. Fys., Vol. 10, Paper 26, 369-72 (1956).

Measurement of the energies of α-particles from the reaction $N^{14}(d,\alpha)C^{12}$ confirmed the recent lower value of 7.66 ± 0.02 MeV (Pauli, Abstr. 7612/1956). The actual value obtained as the mean of two determinations was 7.658 ± 0.027 MeV. A.O.Stanesby

539.152.1 : 539.163.2

3532. AN EXCITED LEVEL OF HIGH SPIN OF Gd^{154}. B.Hartmann and T.Wiedling.
Ark. Fys., Vol. 10, Paper 24, 355-6 (1956).

$\gamma-\gamma$ angular correlation measurements on the cascaded γ-rays of 1.42 MeV and 123 keV from the long-lived excited state of Gd^{154} at 1.54 MeV gave $A_2 = 0.219 \pm 0.005$, $A_4 = -0.003 \pm 0.007$, for the coefficients A_2, A_4 in the angular correlation $W(\theta) = 1 + A_2P_2(\cos\theta) + A_4P_4(\cos\theta)$, in agreement with the theoretical values $A_2 = 0.2208$, $A_4 = -0.0018$ assuming pure multipole transitions and a spin I = 6 for the 1.54 MeV state. A.O.Stanesby

539.152.1 : 539.172.13

3533. AN INVESTIGATION OF THE ENERGY LEVELS OF ALUMINIUM AND BORON NUCLEI BY MAGNETIC ANALYSIS. L.M.Khromchenko.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1037-40 (1954). In Russian.

Detailed results are given of studies of $Al^{27}(d,p)Al^{28}$ at 3.05 and 4.31 MeV and of $B^{10,11}(d,p)B^{11,12}$ at 4.15 MeV. Four new energy levels in Al^{28} are claimed at 6.641, 7.013, 7.197 and possibly 7.896 MeV. W.O.Lock

539.152.1

3534. AN INVESTIGATION OF THE FIRST ROTATIONAL LEVEL OF ^{169}Tm. A.Bisi, S.Terrani and L.Zappa.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 758-63 (Oct., 1956).

The possibility of the β-decay of Er^{169} to the known rotational levels of Tm^{169} has been investigated. No evidence of a complex decay was found. The transition energy results were: $E_0 = (340 \pm 2)$ keV and the half-life $T_{1/2} = (9.0 \pm 0.2)$ days. The low-energy transitions of Tm^{169} from the decay of Yb^{169} were investigated with a proportional counter spectrometer and by using a coincidence technique. The 23.4 keV γ-ray arising in the transition between the third and the second rotational levels was observed; its relative intensity was obtained. No clear evidence was found of a γ-ray which should have arisen from the de-excitation of the first rotational level. A.

539.152.1

3535. COMPOUND STATES OF THE SYSTEM Ni^{58} + p. J.P.Schiffer, M.S.Moore and C.M.Class.
Phys. Rev., Vol. 104, No. 6, 1661-6 (Dec. 15, 1956).

A Ni^{58} target was bombarded by protons from 2 to 5 MeV in energy. Approximately 70 resonances were observed in the yield of the γ-radiation due to inelastic scattering from the state at 1.45 MeV. Angular distributions were obtained for this radiation at 37 resonances. Nineteen of the distributions are consistent with a $5/2^+$ assignment and seventeen fit a 3/2 assignment, while one distribution was isotropic. All the resonances observed had a width no greater than the target thickness of 4 keV. Absolute yields for the reaction have been determined. The level spacing for states formed by d-wave protons was found to be approximately 30 keV in the region studied. An estimate of the value of $\langle\gamma^2\rangle_{Av}/D$ for these resonances gives 1.4×10^{-14} cm. In order to determine the energies of excitation in Cu^{59}, to which these resonances would correspond, the end point of the Cu^{59} beta spectrum was measured, and found to be 3.75 ± 0.1 MeV. This puts the range of excitation for the resonances observed between 6.3 and 7.9 MeV. A.

539.152.1

3536. LOW-LYING STATES OF N^{16}. D.H.Wilkinson.
Phys. Rev., Vol. 105, No. 2, 686-91 (Jan. 15, 1957).

The gamma-rays of low energy resulting from the reaction $N^{15}(d,p)N^{16}$ have been studied. Gamma-rays of energy 387 ± 5, 268 ± 5 and 118 ± 3 keV are observed by using NaI scintillation techniques, and the presence of another gamma-ray of 285 ± 8 keV is inferred. These results indicate states of N^{16} at 118, 285 and 387 keV consistent with earlier studies of heavy particles. The gamma-ray of 268 keV results from a cascade from the 387 keV state through the first excited state which is shown to have a lifetime of a few microseconds. By combining these results with the earlier work on heavy particles, it is possible to fix the first excited state of N^{16} as 0– and the third as 1–. The second excited state is with very good probability 2– or 3– with a slight preference for 3–. The ground state is already known to be 2–. These results are in good accord with the theoretical (shell model) predictions of J.P.Elliott. A.

539.152.1

3537. LEVEL STRUCTURE OF Li^6. D.H.Lyons.
Phys. Rev., Vol. 105, No. 3, 936-44 (Feb. 1, 1957).

A theoretical level structure for Li^6 is calculated for the Hu–Massey Gaussian-shape tensor potential and for the Pease–Feshbach Yukawa interaction. The central force splittings are assumed equal to the first-order Majorana separation. The additional splittings produced by the tensor force of the S and the D states of Li^6 are computed by using a variational method which includes the effect of configuration interaction. An S-state splitting of approximately 2 MeV is found, when the Pease–Feshbach potential is used, with 90% admixture of excited states introduced into the zero-order wave-functions. It is shown that the tensor force has little effect on the separation of the $^1S_0$ and $^1D_2$ states. For the Hu–Massey potential, the triplet D states are split in essentially the same way as would result in first order from a vector-type spin-orbit force. In the case of the Pease–Feshbach potential, the effective first-order potential also includes a tensor term, smaller than and opposite sign to the original tensor force. With both potentials, a total multiplet splitting of about 1 MeV is obtained, with the $^3D_3$ state lowest. A.

539.152.1

3538. ENERGY LEVELS OF Ca^{43}. C.M.Braams.
Phys. Rev., Vol. 105, No. 3, 1023-7 (Feb. 1, 1957).

The $Ca^{42}(d,p)Ca^{43}$ and $Ca^{43}(p,p')Ca^{43}$ reactions were investigated with an electrostatic generator and a magnetic broad-range spectrograph. Bombarding energies from 5.0 to 7.4 MeV were used; targets were made of magnetically separated isotopes. The Q-value of the $Ca^{42}(d,p)Ca^{43}$ ground-state transition is 5.711 ± 0.010 MeV. Thirty excited states of Ca^{43} in the region below 3.43 MeV are well established. A.

539.152.1 : 539.172.13

3539. THE 440 keV TRANSITION IN ^{23}Na. R.Berenbaum, J.H.Towle and J.H.Matthews.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 858-61 (Nov., 1956).

Na^{23} was excited in the $Na^{23}(p,p')Na^{23*}$ reaction and α_K ($4.9 \pm 0.6 \times 10^{-5}$) for the 440 keV γ-ray was determined. The angular distribution of this radiation was found to be $1 - 0.18 \times (\pm 0.02)\cos^2\theta$ at the 1.29 MeV resonance and $1 - 0.12\ (\pm 0.01)\cos^2\theta$ at 1.46 MeV. These results are consistent with the transition being predominantly M 1 and the 440 keV state having a spin of 5/2. M.A.Grace

539.152.1 : 530.145

GROUND STATE OF H^3. See Abstr. 3005

539.152.1

3540. LIFETIMES OF THE FIRST EXCITED STATES OF B^{10} AND Al^{28}. J.C.Severiens and S.S.Hanna.
Phys. Rev., Vol. 104, No. 6, 1612-16 (Dec. 15, 1956).

The lifetimes were measured by a recoil technique which incorporates coincidence counting. Recoil nuclei are produced in a unique manner which facilitates an accurate determination of the recoil velocity. Corrections to the velocity for target thickness were investigated experimentally. Lifetimes of $(8.5 \pm 2.0) \times 10^{-10}$ sec and $(3.0 \pm 0.5) \times 10^{-9}$ sec were obtained for the first excited states of B^{10} and Al^{28}, respectively. A.

539.152.2

3541. SPECTROSCOPIC INVESTIGATIONS OF SEPARATED KRYPTON ISOTOPES. E.Rasmussen and V.Middelboe.
K. Danske Vidensk. Selsk.,mat.-fys. Medd.; Vol. 30, Paper 13, 21 pp. (1955).

The isotope shifts of the even isotopes show that the motion of the nucleus correction holds, except for the deepest term, for which the effect due to correlations in the motions of electrons is present. Careful experiments on Kr^{83} confirm the spin value 9/2, while the deviations from the Landé rule indicate a nuclear quadrupole moment of $(0.22 \pm 0.02)\ 10^{-24}$ cm^2. L.Pincherle

539.152.2

3542. MAGNETIC MOMENT OF THE PROTON IN BOHR MAGNETONS. P.Franken and S.Liebes, Jr.
Phys. Rev., Vol. 104, No. 4, 1197-8 (Nov. 15, 1956).

The nuclear magnetic resonance frequency of protons in mineral oil and the cyclotron frequency of free low-energy electrons are measured in the same magnetic field. The ratio of these two frequencies yields the proton moment in Bohr magnetons. This is found experimentally and corrections which must be made are discussed. When combined with the data available for the magnetic moment of the free electron, this gives the value 1.001165 ± .000011 in terms of Bohr magnetons, which is well outside the theoretical estimate inclusive of fourth order corrections (Abstr. 3776/1950). G.E.Brown

539.152.2

3543. QUADRUPOLE MOMENTS OF Os^{189}, Ta^{181}, Lu^{175}, AND La^{139}. K.Murakawa and T.Kamei.
Phys. Rev., Vol. 105, No. 2, 671-2 (Jan. 15, 1957).

The quadrupole moment of Os^{189} was determined from the hyperfine structure of the level $5d^6 6s^2\ ^5D_4$ of Os I and was found to be $Q(Os^{189}) = (+0.8 \pm 0.2) \times 10^{-24}$ cm^2 without shielding correction. The quadrupole moments (without shielding correction) of Ta^{181}, Lu^{175} and La^{139} that were determined previously from the configurations $5d^3 6s^2$, $5d6s^2$ and $5d^2 6s$ respectively are, in units of 10^{-24} cm^2, $+3.9 \pm 0.4$, $+5.1 \pm 0.3$ and $+0.5 \pm 0.2$ respectively. If one assumes a shielding correction of -0.3 for the 5d electron, these values become $Q(Os^{189}) = +0.6 \pm 0.14$, $Q(Ta^{181}) = +2.7 \pm 0.3$, $Q(Lu^{175}) = +3.6 \pm 0.2$, and $Q(La^{139}) = +0.3 \pm 0.1$ in units of 10^{-24} cm^2, where the probable error does not include the uncertainty of the shielding correction. A.

539.152.2

3544. DETERMINATION OF THE SIGNS OF NUCLEAR SPIN–SPIN INDIRECT COUPLING CONSTANTS. G.A.Williams and H.S.Gutowsky.
J. chem. Phys., Vol. 25, No. 6, 1288-9 (Dec., 1956).

It is shown how measurements of the fully resolved n.m.r. hyperfine patterns for more than one nucleus may be used to determine relative signs for the spin/spin coupling constants. For 1, 4 difluoro-2, 3, 6 trichlorobenzene the H/F coupling is 8.5 c/s in the ortho positions and 6.2 c/s in the para positions and that both couplings have the same sign. D.H.Whiffen

539.152.2

3545. ISOTOPIC SPIN SELECTION RULES. VIII. CHARGE INDEPENDENCE AND THE COMPARISON OF ISOBARIC TRIPLETS. D.H.Wilkinson.
Phil. Mag. (Eighth Ser.), Vol. 1, 1031-42 (Nov., 1956).

For Pt VII see Abstr. 5307 (1956). The experimentally-determined positions of the first T = 1 states of self-conjugate nuclei up to Ca^{40} are compared with their positions calculated from the known ground state mass differences of the $T_z = +1$ and $T_z = 0$ isobars. The Coulomb correction is made in a completely automatic manner that does not involve an assumed nuclear radius but uses the experimental energy difference in the corresponding mirror pair. Close correspondence between calculated and experimental positions is found, the former being on the average higher by 35 keV. If this difference is taken to reflect a departure from equality of the n–n and n–p singlet forces the latter is stronger by about 1% (square well). This is to be compared with the difference of 3% (square well) in the same sense found between p–p and n–p singlet forces from the zero energy scattering lengths. A.

539.152.2

3546. SPIN RELAXATION PROCESSES IN A TWO-PROTON SYSTEM. N.Bloembergen.
Phys. Rev., Vol. 104, No. 6, 1542-7 (Dec. 15, 1956).

The general theory of nuclear spin relaxation, based on the Boltzmann transport equation for the density matrix, is applied to the very simple, nontrivial system of two identical spins $I = \frac{1}{2}$. A proton pair undergoing hindered rotation around one axis shows a resolvable doublet. The relaxation processes in this doublet are investigated. Explicit formulae for the longitudinal and transverse relaxation times are derived, which display a dependence on the angles of the axis of rotation with the external magnetic field and the radius vector. Experimental evidence for this dependence is discussed. General expressions for Overhauser and saturation effects with two applied radiofrequency fields are given, which may also be applied to a magnetic ion or nucleus with I = 1 and crystalline field splitting. A.

539.152.2 : 539.132

NUCLEAR ELECTRIC QUADRUPOLE MOMENT OF U^{235}. See Abstr. 2486

539.152.2 : 539.172.13

SPIN AND PARITY OF Ne^{20}, B^{10}, Mg^{24}. See Abstr. 2636

539.152.2.

3547. R.F. SPECTROGRAPH FOR THE STUDY OF NUCLEAR QUADRUPOLE RESONANCE. M.Buyle-Bodin.
Onde élect., Vol. 35, 485-6 (May, 1955). In French.

539.152.2 : 550.38.08

3548. THEORETICAL AND EXPERIMENTAL STUDY OF THE FORMS OF THE CURVES OBTAINED IN NUCLEAR MAGNETIC RESONANCE. J.M.Rocard.
Arch. Sci. (Geneva), Vol. 9, No. 3, 237-61 (1956). In French.

A discussion of Bloch's equations and their solutions as ΩT_2 is $>$, $= <1$, where Ω is the low frequency of the modulation field. T_2 is measured for $Fe(NO_3)_3$ solutions down to N/1000, where $T_2 = 5.5 \times 10^{-2}$ sec. The earth's magnetic field at Jussy is measured to be 0.4522 ± 0.0001 G essentially by finding the additional field required to give resonance at exactly 3 kc/s. D.H.Whiffen

539.152.2

3549. ANISOTROPIC CHEMICAL SHIELDING AND NUCLEAR MAGNETIC RELAXATION IN LIQUIDS. H.M.McConnell and C.H.Holm.
J. chem. Phys., Vol. 25, No. 6, 1289 (Dec., 1956).

It is shown that if $\Delta\sigma$ is the difference of the n.m.r. shielding tensor elements for fields parallel and perpendicular to the local symmetry at the nucleus then there is a spin–lattice relaxation time contribution given by

$$(1/T_1) = (8\pi^2/15)(\Delta\sigma)^2 \nu_0^2 \tau_c^2/(1 + 4\pi^2 \nu_0^2 \tau_c^2).$$

D.H.Whiffen

539.152.2 : 536.53

PRECISE NUCLEAR RESONANCE THERMOMETER. See Abstr. 3212

539.152.4

3550. THEORY OF HYPERFINE STRUCTURE. C.Schwartz.
Phys. Rev., Vol. 105, No. 1, 173-83 (Jan. 1, 1957).

Numerical values for the one-electron integrals of interest in the analysis of atomic hyperfine structure have been calculated by using screened relativistic wave-functions. Ratios of these integrals, representing the relativistic correction factors of Casimir, are given to replace the older values which neglected shielding effects. The most marked changes occur in the studies of the octopole interaction and h.f.s. anomalies in p-states. The calculated one-electron magnetic dipole integral, when compared with the experimental ratio, dipole h.f.s./nuclear moment, makes it possible to deduce the magnitude of atomic polarization (Sternheimer) effects. In the doublet p-states that were studied, the polarization terms seem to be almost entirely of the sort discussed in an earlier paper: excitation of s-slectrons. In a general discussion of polarization calculations some explanation is given of the large correction factors for the fine structure, dipole and quadrupole hyperfine structure that were calculated by Sternheimer (the radial redistribution of charge terms). It is also suggested that large polarization corrections may be needed for the octopole interaction. A.

539.153

3551. CORRELATION ENERGIES IN ATOMS AND ELECTRON AFFINITIES. T.Arai and T.Onishi.
J. chem. Phys., Vol. 26, No. 1, 70-4 (Jan., 1957).

The well-known orbital approach is applied to the 2, 3, and 4 electron systems of atoms and ions, and the extent to which it can be applied and the apparent nature of the correlation energies are surveyed. It is then discussed how the apparent correlation energies can be extrapolated to estimate the correct energy values of negative ions for which observation has not yet succeeded. According to such estimates, the electron affinities of H and Li are obtained as 0.75 ± 0.01 eV and 0.66 ± 0.03 eV, respectively. Finally it is attempted to extend the discussion to more complicated systems. A.

539.153

3552. HYPERFINE STRUCTURE OF THE METASTABLE DEUTERIUM ATOM. H.A.Reich, J.W.Heberle and P.Kusch.
Phys. Rev., Vol. 104, No. 6, 1585-92 (Dec. 15, 1956).

The hyperfine separation $\Delta\nu(2S;D)$ of the metastable $2\ ^2S_{1/2}$ state of the deuterium atom has been measured by an atomic-beam magnetic-resonance method that has been described previously. It was found that $\Delta\nu(2S;D) = 40\,924.439 \pm 0.020$ kc/s. This result and the ground-state separation $\Delta\nu(1S;D)$ gives $R(D) \equiv \Delta\nu(2S;D)/\Delta\nu(1S;D) = \frac{1}{8}(1.000\,034\,2 \pm 0.000\,000\,6)$. Comparison of this value with the corresponding quantity for hydrogen, $R(H) = \frac{1}{8}(1.000\,034\,6 \pm 0.000\,000\,3)$, confirms within experimental error the theoretical prediction that R(D) = R(H). A.

539.153 : 535.33.03

3553. MICROWAVE TECHNIQUE FOR DETERMINING THE FINE STRUCTURE OF THE HELIUM ATOM. W.E.Lamb,Jr.
Phys. Rev., Vol. 105, No. 2, 559-72 (Jan. 15, 1957).

A new technique of microwave spectroscopy is proposed for application to excited states of short lifetime. If atoms are excited by electron bombardment, closely-spaced energy levels may be unequally populated. The radiation emitted in decay to lower states may have an angular distribution and polarization character correlated with the direction of bombardment. When such atoms are acted

on by radiofrequency fields, transitions may occur between excited states which cause an observable change in the pattern of decay radiation. An analysis is made of the possibility of applying such a method to a determination of the fine-structure patterns $(1snp)\,^3P_J$ (J = 0, 1, 2) of the helium atom. After a review of previous optical spectroscopic work and theory of this fine structure, an old unsolved mystery concerning the polarization of collision light is discussed. The theory of the Zeeman effect is worked out in a form applicable to the microwave experiments. Expected transition frequencies and r.f. matrix elements, intensity changes and shape of resonance curves, Stark effect and singlet-triplet mixing are also considered. An estimate is made of the signal to be expected in the experiment described in the following abstract. A.

539.153 : 535.33.03

3554. MEASUREMENT OF THE FINE STRUCTURE SEPARATION $3\,^3P_1 - 3\,^3P_2$ FOR THE HELIUM ATOM. W.E.Lamb,Jr and T.H.Maiman.
Phys. Rev., Vol. 105, No. 2, 573-9 (Jan. 15, 1957).

The fine structure of helium levels $(1s3p)\,^3P_J$, J = 1, 2 is determined by the microwave-optical method outlined in the preceding abstract. Helium atoms are excited to $3\,^3P_J$ by electron bombardment and the optical radiation $3\,^3P_J \rightarrow 2\,^3S_1$ (3889 A) is observed with a photomultiplier tube. The intensity of this radiation changes when radio waves induce transitions between the fine structure sublevels. The separation $3\,^3P_1 - 3\,^3P_2$ is found to be 658.0 ± 1.0 Mc/s, which is to be compared to the most recent optical estimates of 750 ± 300 Mc/s. A.

539.153

3555. MAGNETIC MOMENTS AND HYPERFINE-STRUCTURE ANOMALIES OF Cs^{133}, Cs^{134}, Cs^{135}, AND Cs^{137}. H.H.Stroke, V.Jaccarino, D.S.Edmonds,Jr and R.Weiss.
Phys. Rev., Vol. 105, No. 2, 590-603 (Jan. 15, 1957).

The atomic-beam magnetic-resonance method was used to measure the nuclear gyromagnetic ratios and hyperfine-structure separations of the radioactive isotopes, Cs^{134}, Cs^{135}, and Cs^{137}. A surface ionization detector was used. The hyperfine-structure separations were obtained by direct $\Delta F = \pm 1$ transitions near zero field. The values of $\Delta\nu$ found for the three isotopes are: $\Delta\nu(Cs^{134})$ = 10 473.626 ± 0.015 Mc/s, $\Delta\nu(Cs^{135})$ = 9 724.023 ± 0.015 Mc/s, $\Delta\nu(Cs^{137})$ = 10 115.527 ± 0.015 Mc/s. Pairs of transition belonging to the two different F-states, but involving the same m_F values, constitute frequency doublets separated by $2g_I\mu_0 H$. From measurements of the difference frequencies of these doublets for pairs of isotopes in fields in the vicinity of 9000 gauss, the following g-value ratios were obtained: $g_I(Cs^{135})/g_I(Cs^{133})$ = 1.058 20 ± 0.000 08, $g_I(Cs^{137})/g_I(Cs^{135})$ = 1.040 05 ± 0.000 08, $g_I(Cs^{134})/g_I(Cs^{133})$ = 1.024 47 ± 0.000 29. The h.f.s. anomalies arising from the variation of the electron wavefunction over the finite distribution of nuclear magnetization were calculated from these measurements. The values found for these anomalies, defined by $\epsilon_2 - \epsilon_1 = [g_1\Delta\nu_2(2I_1 + 1)]/[g_2\Delta\nu_1(2I + 1)] - 1$, are: $\epsilon(Cs^{133}) - \epsilon(Cs^{135})$ = +0.037 ± 0.009%, $\epsilon(Cs^{135}) - \epsilon(Cs^{137})$ = −0.020 ± 0.009%, $\epsilon(Cs^{133}) - \epsilon(Cs^{134})$ = +0.169 ± 0.030%. The theory of Bohr and Weisskopf on the h.f.s. anomalies was applied to these nuclei; the calculations are based primarily on a single-particle model with varying distributions of spin and orbital contribution to the nuclear moment. An apparent magic number effect in the anomalies was observed. A.

539.153

3556. STATISTICAL THEORY OF MANY-ELECTRON SYSTEMS. GENERAL CONSIDERATIONS PERTAINING TO THE THOMAS–FERMI THEORY. S.Golden.
Phys. Rev., Vol. 105, No. 2, 604-15 (Jan. 15, 1957).

The density matrix for a many-electron system has been examined with a view toward extending the statistical theory of Thomas and Fermi. The single-particle density matrix is expanded in terms of a power series in $\hbar$, according to a procedure developed here for operators consisting of a series of powers of the classical Hamiltonian, the zeroth-order terms corresponding to the Thomas–Fermi theory. Second-order terms in the expansion are identifiable in the expression for the energy: they correspond to exchange energy, the Weizsäcker inhomogeneity correction for the kinetic energy and, possibly, correlation energy. Their presence follows from the expansion procedure, rather than from an a priori insertion into the theory. While the development here has been concerned mainly with the single-particle density function at the absolute zero of temperature, the procedure has been developed in sufficiently general terms to permit an evaluation to be made of the many-electron density matrix as a function of temperature. The results which have been obtained have been utilized to modify the theory of Fermi and Amaldi which has then been applied to the following atomic states: H (^{2}S), He (^{1}S), He (^{3}S), C^{++} (^{1}S), O (^{1}S). The disparity between the calculated energy for He (^{3}S) and the observed value is less than 6%, while for the remaining cases the disparity does not exceed 2.5%. The radial densities obtained correspond roughly to available quantum densities; they fail, however, to indicate any "shell-structure" or to display the expected behaviour for distances very close to, or very far from the atomic nucleus. A.

539.153

3557. PARAMAGNETIC RESONANCE OF HYDROGEN ATOMS TRAPPED AT LIQUID HELIUM TEMPERATURE. C.K.Jen, S.N.Foner, E.L.Cochran and V.A.Bowers.
Phys. Rev., Vol. 104, No. 3, 846-7 (Nov. 1, 1956).

The electron resonance spectra are observed of H and of D atoms formed by a 4 Mc/s, 100 watt discharge in their respective molecular gases,the products being trapped at liquid He temperature. The hyperfine splittings are 1417.13 and 326.60 Mc/s respectively, which are 0.23% lower than in the free atoms. Further lines of unknown origin may be due to excited states and there are also satellites involving the simultaneous transitions in the orientation of neighbouring nuclei. D.H.Whiffen

539.153 : 537.534.75

STOPPING POWER AND VALENCE STATES. See Abstr. 2337

539.153.4

3558. GROUPING OF ELECTRONS ACCORDING TO THE PRINCIPAL QUANTUM NUMBER IN THE STATISTICAL THEORY OF ATOMS. P.Gombás.
Acta. Phys. Hungar., Vol. 5, No. 4, 503-10 (1956). In German.

An additional potential, bearing a simple relation to the approximate analytical functions introduced by Slater (Phys. Rev., Vol. 36, 57, 1930) may be used to calculate electron grouping as related to the principal quantum number. Further, without any additional hypothesis, it is shown empirically that the occupation of electronic states with small azimuthal quantum numbers is preferred to those with large azimuthal quantum numbers. A.J.Mee

539.153.4

3559. AN APPROXIMATION TO THE THOMAS–FERMI FUNCTION. T.Tietz.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1192-4 (Nov., 1956). In German.

An approximate solution of simple form is given, and its error is discussed in detail. P.M.Davidson

539.153.4

3560. GROUND STATE WAVE FUNCTIONS FOR He I AND H^- OBTAINED BY THE SUPERPOSITION OF CENTRAL FIELD FUNCTIONS. L.C.Green, C.D.Chandler and P.P.Rush.
Phys. Rev., Vol. 104, No. 6, 1593-5 (Dec. 15, 1956).

The ground-state wave-functions of He I and H^- have been represented by the superposition of symmetrized analytic central field wave-functions for the configurations $1s^2$, 1s2s, 1s3s, $2p^2$, 2p3p, $3d^2$ and $4f^2$. The radial functions were taken to be the product of an exponential and a polynomial. The coefficients in the polynomials were chosen to insure the orthogonality of the one-electron wavefunctions. The parameters in the exponentials and the coefficients in the linear combinations of the wave-functions for the different configurations were chosen so that the ground-state function gave the minimum energy. The resulting energies for He I and H^- are −5.798 30 and −1.051 90 respectively in units of the Rydberg for the corresponding atom. These results together with others are discussed. A.

539.153.4

3561. EXTENSION OF THE THOMAS–FERMI–DIRAC STATISTICAL THEORY OF THE ATOM TO FINITE TEMPERATURES. R.D.Cowan and J.Ashkin.
Phys. Rev., Vol. 105, No. 1, 144-57 (Jan. 1, 1957).

The Thomas–Fermi theory of the atom is generalized to include the effects of temperature as well as exchange. This leads to a nonlinear integral equation for the Fermi electron-momentum distribution function, and the usual Poisson equation for the electron-density distribution. Analytical solutions of the integral equation are given for the limiting cases of near-degeneracy and complete nondegeneracy, and a numerical method of calculating solutions in the intermediate case is described. A complete discussion of the thermodynamics of the atom is given; in particular, it is shown that the Gibbs free energy is the product of the number of electrons and the electronic chemical potential (Fermi energy), despite statements which have been made to the contrary. Numerical results have verified the virial theorem for all Z, T, and atomic volumes. The ratio of the calculated energy for $T = \mathcal{P} = 0$ to the

experimental total ionization energy varies from 2.07 for H down to 1.33 for Al, and is presumably still closer to unity for higher-Z elements. Some numerical results are given for iron over the density range 0.1 to 10 times normal and for values of kT from 0 to 1000 eV. Pressures, energies, and entropies are lower than the corresponding values calculated without exchange by as much as 40% at kT = 10 eV, by up to 10% at kT = 100 eV, and by only negligible amounts at kT = 1000 eV. A.

539.153.4

3562. APPLICATION OF THE RAYLEIGH–SCHRÖDINGER PERTURBATION THEORY TO THE HYDROGEN ATOM.
A.Dalgarno.
Proc. Phys. Soc. A, Vol. 69, Pt 10, 784-5 (Oct., 1956).

Regarding the atom with nuclear charge Z as an atom with nuclear charge Z' perturbed by the field of a nuclear charge Z–Z', it is shown that provided Z' is not taken as zero the energy calculated by the perturbation theory becomes correct at the second order and that the higher orders vanish. P.M.Davidson

539.153.4 : 530.145

PROTON STRUCTURE AND THE HYPERFINE SHIFT IN HYDROGEN. See Abstr. 2983

539.155.2 : 539.172.4

3563. ISOTOPIC ANALYSIS OF GASEOUS BORON HYDRIDES BY NEUTRON ABSORPTION. R.P.Hamlen and W.S.Koski.
Analyt. Chem., Vol. 28, No. 10, 1631-2 (Oct., 1956).

An isotopic boron analysis of diborane and pentaborane containing varying amounts of B^{10} has been made using a neutron absorption technique. The gas was placed in a cell, the inside of which was coated with a silver-activated zinc sulphide phosphor, and exposed to a neutron flux. The number of events from the $B^{10}(n,\alpha)Li^7$ reaction was a measure of the B^{10} content. The accuracy and reproducibility of the results agreed to within 1% with mass-spectroscopic analysis of the same materials. Preliminary results indicate the method is applicable to other gaseous boron hydrides such as dihydropentaborane and tetraborane. A.

539.155.2

3564. ON THE ISOTOPIC CONSTITUTION OF POTASSIUM. A STUDY OF MASS DISCRIMINATION IN A HOT ANODE ION SOURCE.
C.Reuterswärd.
Ark. Fys., Vol. 11, Paper 1, 1-54 (1956).

Problems involved in determining absolute abundance ratios are discussed, and results for the K^{39}/K^{41} ratio reviewed. It is suggested that calibration by synthetic samples of different substances may not eliminate systematic errors. Various methods of preparation for surface-ionization sources are discussed; coated filaments are preferred. Construction of a 180^0 instrument is described and a detailed account of auxiliary equipment given. Instrumental errors are examined theoretically and experimentally. Results for the K^{39}/K^{41} ratio are reported, various methods of source preparation being employed. Measurements on powdered leucite give a value 14.25 ± 10, and diluted solutions of pure salts give lower values, coating thickness having considerable influence. Solutions of natural samples give results ranging from 14.07 ± 4 for sea-water to 13.68 ± 8 for a Pacific kelp. After chemical treatment of the latter sample to isolate a pure salt, the measured ratio increased. Including the various corrections, a final value of 13.57 ± 9 is quoted. Measurements made using thicker coatings are criticized. It is concluded that calibration of the spectrometer by synthetic isotopic mixtures of potassium should clarify the results. Previous data for the K^{39}/K^{40} ratio, (Abstr. 3805/1952), are reported and a new evaluation given. N.M.King

539.155.2 : 537.534.3

3565. THE ISOTOPIC ANALYSIS OF BORON BY MASS SPECTROMETRY. G.H.Palmer, D.F.Dance and K.L.Aitkew.
Atomic Energy Res. Establ. (Harwell) Ref. GP/R1994, 4 pp. (1956).

The problems associated with this analysis are explained, in particular the "memory effect" when samples of widely differing B^{10}/B^{11} ratios are analysed consecutively on the same instrument. BF_3 gas is used as the working material in a gas-type mass spectrometers. Details of three different types of sample manifold are given and their respective merits discussed. A solid-source technique using boron is also described. H.C.Cole

539.155.2 : 541.13

3566. THE SEPARATION OF Mn^{54}, Co^{56}, Co^{58}, Zn^{65} AND Nb^{95m} IN A CARRIER-FREE STATE BY THE USE OF ANION EXCHANGE RESIN. C.E.Mellish.
Atomic Energy Res. Establ. (Harwell) Mem. I/M39, 4 pp. (1956).

The preparation of the above isotopes is described. For the separation De-Acidite FF anion exchange resin was used in strongly acid solution. The metals concerned form anionic complexes of varying stability and absorbability, and the separations were effected by choosing acid strengths appropriate to adsorption or elution. Details of the preparation of a Nb^{95} source containing less than 2% Zr are given. H.C.Cole

539.155.2

3567. ON THE EXCESS FREE ENERGY OF ISOTOPIC MIXTURES. J.Henry.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 2, 163-72 (1956). In French.

This is due to two distinct contributions, one appearing when the isotopes are mixed at constant volume (constant volume effect) the other when the volume is subsequently changed so that the pressure of the mixture equals the original pressure of the components (volume effect). The latter had previously been shown to be positive (Abstr. 913/1955). A recently published general expression for the constant volume effect (Abstr. 3128/1956) is applied to a lattice of harmonic oscillators and to a hard sphere gas. In both cases the constant volume effect is small compared with the volume effect. H.London

539.155.2

3568. RECOIL SEPARATION OF ISOTOPES. K.H.Sun and F.A.Pecjak.
Nucleonics, Vol. 14, No. 11, 122, 124-6 (Nov., 1956).

The recoil of nuclei after emission of massive particles as a result of nuclear reactions enables the nuclei to be collected on a separate catcher foil. Al^{28} nuclei from the reaction, Al^{27}(d, p) Al^{28}, and A^{41} from the reaction A^{40}(d, p) A^{41} were collected on Ta foils and identified by following their decay. It is suggested that the bombardment of multiple foils by fast neutrons may be used for the efficient preparation and separation of nuclear isotopes. R.D.Smith

539.155.2

3569. MASS SPECTROMETRIC INVESTIGATION OF THE RARE EARTH ELEMENTS FOR THE EXISTENCE OF NEW STABLE ISOTOPES. T.L.Collins, F.M.Rourke and F.A.White.
Phys. Rev., Vol. 105, No. 1, 196–7 (Jan. 1, 1957).

An earlier study for new isotopes in nature among the more familiar elements has been extended to include yttrium and the rare earth elements. No new isotopes were discovered, but better upper limits have been assigned in most cases. A.

539.155.2 : 537.534.3

3570. POSSIBLE APPLICATION OF CYCLOTRON RESONANCE TO MASS SPECTROSCOPY. V.N.Lazukin.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 339-40 (1956). In Russian.

The possibility of revealing the diamagnetic ("cyclotron") resonance absorption of radio or microwaves (theoretically predicted by Dorfman (Abstr. 7404/1952) and experimentally observed in semiconductors by various authors) in ion plasmas is suggested as a method to measure with very high accuracy the relative abundance of very small quantities of isotopes. G.Martelli

539.155.4

3571. ATOMIC MASSES IN THE S-Ti REGION FROM PRECISION Q-VALUE MEASUREMENTS. P.M.Endt, W.W.Buechner, C.M.Braams, C.H.Paris and A.Sperduto.
Phys. Rev., Vol. 105, No. 3, 1002-5 (Feb. 1, 1957).

Masses of twenty-seven nuclides from S^{32} to Ti^{45} have been computed from precision (error $\leq$ 20 keV) Q-value measurements. A number of mass cycles occur which were used for statistical adjustment of the input data. The final masses, obtained by taking as a reference point the S^{32} mass published by Nier and co-workers, are compared to the values measured with mass spectrographic and microwave methods. A.

539.155.4

3572. ATOMIC MASSES IN THE REGION XENON TO EUROPIUM.
W.H.Johnson, Jr and A.O.Nier.
Phys. Rev., Vol. 105, No. 3, 1014-23 (Feb. 1, 1957).

A 6 in. double-focusing mass spectrometer employing the peak matching method of measurement has been used to measure 36 atomic masses in the region $130 \leq A \leq 154$ and $54 \leq Z \leq 63$. Atomic masses of 41 radioactive nuclei have then been calculated from mass differences derived from nuclear reaction and β-decay energies. Nucleon binding and pairing energies have been calculated from the resulting mass table. The effect of the shell closure at N = 82 on the systematics of nuclear binding and pairing energies has been investigated in greater detail than has previously been possible. The discontinuity in neutron binding energy, observed in reaction measurements and β-decay systematics, is shown to be caused by a decrease

in binding energy of neutrons beyond N = 82 rather than a particular large binding energy at N = 82. The systematic behaviour of proton binding and pairing energies is also studied. The nucleon binding and pairing energy results show departures from uniformity in the region near N = 90. Electric quadrupole systematics have also indicated a change in nuclear structure in this region. The present atomic masses are also employed in the isotopic identification of several reactions, in the study of several natural alpha-decays, and in the interpretation of several β-decay disintegration schemes. A.

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08

3573. CELLOPHANE-DYE DOSIMETER FOR 10^5 TO 10^7 ROENTGEN RANGE. E.J.Henley and D.Richman.
Analyt. Chem., Vol. 28, No. 10, 1580-2 (Oct., 1956).

This paper describes a recording integrating chemical dosimeter, capable of measuring gamma and beta doses from 200 000 to 10 000 000 roentgens. Calibration curves are presented for 0.8, 2, and 3 MeV beta-radiation, and for a Co^{60} gamma-source over a dose rate range of 10^5 to 10^7 roentgens per hour. The dosimeter is fabricated from commercially available cellophane, and is convenient, inexpensive, and stable. A.

539.16.08

3574. SCINTILLATING GELS. B.L.Funt.
Nucleonics, Vol. 14, No. 8, 83-4 (Aug., 1956).

The preparation of scintillating gels by addition of 5% aluminium stearate to a liquid scintillator (e.g. PBD in xylene) is described. Radioactive material can readily be incorporated in the gel enabling α- and β-emitters to be counted in good geometry. R.D.Smith

539.16.08

3575. SUSPENSION COUNTING IN SCINTILLATING GELS. C.G.White and S.Helf.
Nucleonics, Vol. 14, No. 10, 46-8 (Oct., 1956).

Details of the preparation and use of a thixotropic scintillating gel made from a solution of PPO in toluene combined with an organic castor oil derivative "Thixcin". The efficiency of the gel as a β-counter for three insoluble C^{14} compounds suspended in the gel in various concentrations and particle sizes has been studied. The method appears suitable for the radioassay of these and other β-emitters. R.D.Smith

539.16.08

3576. DIODE-PHOTOTUBE MONITOR USES LIQUID SCINTILLATOR. W.R.Lamb.
Nucleonics, Vol. 14, No. 8, 84-5 (Aug., 1956).

Details of a portable radiation detector giving an output current of 1.1×10^{-10} A in a radium-gamma radiation field of 1.0 r/hr. R.D.Smith

539.16.08

3577. A GAMMA-DISCRIMINATING BETA SURVEY METER. W.F.Joseph and R.M.Bond.
Nucleonics, Vol. 14, No. 9, 108-10 (Sept., 1956).

A detailed description of a portable instrument responding to the differential between a β—γ sensitive parallel plate ion-chamber and a similar chamber shielded from β-radiation. R.D.Smith

539.16.08

3578. ANALYSIS OF U AND Th MINERALS BY ALPHA SPECTRUM. U.Facchini, M.Forte, A.Malvicini and T.Rossini.
Nucleonics, Vol. 14, No. 9, 126, 128-31 (Sept., 1956).

The preparation of thin samples for mounting in a grid ionization chamber is described. α-particles from the various decay products of U and Th can be resolved and identified. This enables the amount of the U and Th present in the sample and the degree of radioactive equilibrium established to be determined. R.D.Smith

539.16.08 : 537.542

3579. COUNTING EFFICIENCY DETERMINATIONS OF Pa^{233}. L.D.McIsaac and E.C.Freiling.
Nucleonics, Vol. 14, No. 10, 65-7 (Oct., 1956).

Sources were prepared by electroplating Pa^{233} on platinum and the β-count compared with the α-count taken after a lapse of 20 halflives. Efficiencies determined in this way were compared with those determined from electrodeposition of Np^{237} on platinum. In this second method the initial α-count was compared with the β-count when the latter had reached equilibrium. It is concluded that the second method is the more precise. R.D.Smith

539.163

3580. TRITIUM-RECOIL LABELING OF ORGANIC COMPOUNDS. F.S.Rowland and R.Wolfgang.
Nucleonics, Vol. 14, No. 8, 58-61 (Aug., 1956).

T-labelled compounds can be produced by fast tritium exchange with hydrogen. The 2.7 MeV tritons from the $Li^6(n,\alpha)$ T reaction can be utilized by irradiating an intimate mixture of the compound required and a lithium salt. The optimum concentration of lithium, particle size and other factors are considered, and the specific activities of various labelled compounds so prepared are listed. The distribution of activity within the labelled compounds is usually non-specific, but non-uniform. R.D.Smith

539.163

3581. ROTATIONAL STATES IN Tm^{171}. S.A.E.Johansson.
Phys. Rev., Vol. 105, No. 1, 189-92 (Jan. 1, 1957).

The decay of Er^{171} has been investigated by means of a coincidence scintillation spectrometer. Eight gamma-rays have been arranged in a level scheme with levels at 5, 118, 130, 337 and 425 keV. Spin and parity values have been assigned to most of the levels. It is found that the first four levels form a rotational band in good agreement with the theoretical formula for the case $K = \frac{1}{2}$. The beta-ray spectrum has been resolved in components which fit very well into the level scheme. The beta- and gamma-ray transition probabilities are discussed. They are found to be in good agreement with the theory. A.

539.163

3582. RADIOACTIVE DECAY OF Ne^{23}. J.R.Penning and F.H.Schmidt.
Phys. Rev., Vol. 105, No. 2, 647-51 (Jan. 15, 1957).

The beta and gamma radiations of 38 sec Ne^{23} have been studied by means of scintillation spectrometer techniques. Beta transitions were found to the ground, first, and second excited states of Na^{23} with end-point energies equal to 4.39 ± 0.05, 3.95 ± 0.05 and 2.4 ± 0.1 MeV, respectively. Their percent intensities and log ft values are: 67 ± 3, 5.25; 32 ± 3, 5.38; and 1.00 ± 0.15, 5.88, respectively. Gamma-rays are coincident with the latter two beta-transitions and with one another; their energies and percent relative intensities are 436 ± 4 keV; 100; 1647 ± 16 keV, 3.0 ± 0.3, respectively. Higher energy gamma-radiation was present in less than 0.2% of all decays. No beta transitions with log ft values in the superallowed group were found. A decay scheme based on the above data is proposed. The half-life of Ne^{23} was remeasured together with the half-lives of O^{15} and Ne^{19}. The results are: Ne^{23}, 37.6 ± 0.1 sec; O^{15}, 123.95 ± 0.50 sec; Ne^{19}, 17.7 ± 0.1 sec. A.

539.163

3583. POSSIBLE EXISTENCE OF Cm^{247} OR ITS DAUGHTERS IN NATURE. H.Diamond, A.M.Friedman, J.E.Gindler and P.R.Fields.
Phys. Rev., Vol. 105, No. 2, 679-80 (Jan. 15, 1957).

The absence of any detectable Pu^{243} daughter activity in a sample of curium containing two micrograms of Cm^{247} indicates that the alpha half-life of Cm^{247} exceeds 4×10^7 years and probably exceeds 9×10^7 years. The possibilities of finding Cm^{247} in nature and of finding high $U^{235} : U^{238}$ ratios in very old rare-earth minerals are discussed. A.

539.163

3584. ISOMER IN IRIDIUM-193. F.Boehm and P.Marmier.
Phys. Rev., Vol. 105, No. 3, 974-6 (Feb. 1, 1957).

An 80.19 keV transition with a half-life of 11.9 days and M4 multipolarity has been observed in a neutron-irradiated sample of iridium. The corresponding isomeric state has been assigned to Ir^{193}, which is produced by two successive neutron captures in Ir^{191}. A pile-neutron capture cross-section of 1500 barns is found for Ir^{192}. A.

539.163

3585. DECAY OF 2.7-HOUR Sr^{92}. R.L.Heath.
Phys. Rev., Vol. 105, No. 3, 1011-13 (Feb. 1, 1957).

The decay of 2.7 hr Sr^{92}, produced as a fission product activity, has been studied using the scintillation method. Gamma-rays of energy 0.23 ± 0.02, 0.44 ± 0.04, and 1.37 ± 0.05 MeV were found, with relative intensities of 0.039 ± 0.004, 0.45 ± 0.004 and 1.00, respectively. Beta-ray spectrometry using anthracene and beta—gamma coincidence studies indicate a major beta of 0.545 ± 0.05 MeV in coincidence with the 1.37 MeV gamma-ray. Comparison with 4π beta measurements indicate a branching ratio of $90 \pm 10\%$ leading to the 1.37 MeV excited state (log ft = 4.3). A.

539.163.08

3586. SIMPLE MEASUREMENT OF THE RELATIVE ACTIVITIES OF SAMPLES OF TRITIATED MATERIALS. E.Matsukawa and C.Eaborn.
Research Correspondence, Vol. 9, No. 10, S37 (Oct. 10, 1956).

Tritium as an indicator for chemical purposes is recommended because of its small danger and low cost. Authors used tritiated water dissolved in dioxan containing 6 g/l terphenyl contained in a glass with polished bottom standing directly on the window of a scintillation counter. The sensitivity (limited by dark current) was estimated to be 2 microcuries. V.Quittner

539.163.1/.2 : 539.172.13

3587. PRODUCTION AND PROPERTIES OF C^{15}. R.A.Douglas, B.R.Gasten and A.Mukerji.
Canad. J. Phys., Vol. 34, No. 11, 1097-111 (Nov., 1956).

Uniform thin C^{14} targets on 2500 A nickel backings were prepared in a discharge tube containing acetylene (enriched to 28.8% C^{14}). A NaI (Tl) crystal was used to measure the yield of C^{15} (2.25 ± 0.05 sec half-life) from C^{14} (d,p)C^{15} at E_d = 1.3 to 3.0 MeV. A 7.5 ± 1.5 sec activity was also observed, presumably N^{16} produced by $C^{14}(d,\gamma)N^{16}$. The C^{15} gamma-ray spectrum indicates only a 5.3 MeV transition. A plastic scintillator was used to measure the C^{15} beta-spectrum. End-point energies of 9.5 ± 0.3 and 4.5 ± 0.2 MeV with a branching ratio of 4 to 1 favouring the lower energy component were observed. The results are consistent with a spin and parity assignment of 1/2(+) for the C^{15} ground state. A.

539.163.1

3588. HALF-LIFE DETERMINATION OF SOME RADIONUCLIDES. W.F.Merritt, P.J.Campion and R.C.Hawkings.
Canad. J. Phys., Vol. 35, No. 1, 16-20 (Jan., 1957).

The half-lives of the following nuclides have been determined by absolute counting techniques using a 4π beta proportional counter. The period over which the observations were made is indicated in brackets. The errors quoted are the statistical counting errors. Na^{22} : 2.58 ± 0.03 years (2 years), Ru^{106} : 1.02 ± 0.01 years (5 years), Cs^{134} : 2.19 ± 0.02 years (5 years), Ce^{144} : 285 ± 2 days (4 years), Pm^{147} : 2.64 ± 0.02 years (4 years), Tl^{204} : 3.56 ± 0.05 years (4 years). A review of previous determinations is included. A.

539.163.1

3589. THE HALF-LIFE OF Ni^{63}. C.C.McMullen, B.D.Pate, R.H.Tomlinson and L.Yaffe.
Canad. J. Chem., Vol. 34, No. 12, 1742-6 (Dec., 1956).

The half-life of Ni^{63} has been found by a specific activity determination to be 125 ± 6 years. The number of atoms of Ni^{63} was determined mass spectrometrically and the disintegration rate by 4π β-counting. The cross-section for the reaction $Ni^{62}(n,\gamma)Ni^{63}$ has been found to be 21 ± 2 barns, in good agreement with that found by Pomerance [Phys. Rev., Vol. 76, No. 1, 195 (July 1, 1949)]. A.

539.163.1

3590. Mo-99 IN URANIUM SALTS AND THE SPONTANEOUS FISSION HALF-LIFE OF URANIUM-238. P.L.Parker and P.K.Kuroda.
J. chem. Phys., Vol. 25, No. 5, 1084-5 (Nov., 1956).

The equilibrium quantity of Mo^{99} in a uranyl nitrate solution was (1.26 ± 0.12) x 10^{-14} curie g^{-1} U^{238}, giving a spontaneous fission half-life for U^{238} of (8.4 ± 0.8) x 10^{15} yr. A.O.Stanesby

539.163.1

3591. DETERMINATION OF THE ABSOLUTE INTENSITY OF WEAK SOURCES OF $_{88}Ra^{226}$ AND $_{90}Th^{228}$. F.Demichelis.
R.C. Accad. Naz. Lincei, Vol. 21, No. 1-2, 91-6 (July-Aug., 1956). In Italian.

The absolute intensity of small sources (0.01 – 0.1 μc) of Ra^{226} is found by counting coincidences between the α-particles and γ-rays from Po^{214}, one of the decay products of Ra^{226}. The intensity may also be measured by counting coincidences between β-particles from Bi^{214} and α-particles from Po^{214}. Sources of Th^{228} (1 – 10 μc) may be measured using $\alpha-\beta$ coincidences from the decay of Th^{228} to Po^{212}. P.Rothwell

539.163.1

3592. LIFETIME OF THE FIRST EXCITED STATE OF B^{10}. S.D.Bloom, C.M.Turner and D.H.Wilkinson.
Phys. Rev., Vol. 105, No. 1, 232-4 (Jan. 1, 1957).

This has been measured at 0.72 MeV as 1.05 ± 0.10 mμsec by bombarding B^{10} with pulsed beams of 3 MeV protons and studying the delayed emission of gamma-rays. This figure is a little longer than that given by earlier measurements of the E2 lifetime using recoil methods. The result is compared with preliminary shell model calculations and it is concluded that it is probably inconsistent with those calculations, at least if one restricts oneself to the value of the intermediate coupling parameter that gives good agreement with the experimental level scheme. It seems that some collective motion must be envisaged even in so light a nucleus as B^{10}. A.

539.163.2

3593. THE MASS ASSIGNMENT OF THE CHAIN 2 MIN. Sb → 77.7 HR. Te → 2.25 HR. I. W.H.Fleming and H.G.Thode.
Canad. J. Chem., Vol. 34, No. 3, 408-9 (March, 1956).

Fission product xenon was extracted from neutron-irradiated uranium and plutonium before all the 77.7 hr tellurium activity had decayed, and the effective half-life of the precursors of Xe^{132} was determined by comparing the relative abundance of Xe^{132} to that of Xe^{134} in these samples with the relative abundance in samples which had been stored for a time long compared to 77.7 hours, using a mass spectrograph. A value of 75 ± 3 hr was obtained confirming the assignment of the 77.7 hr tellurium activity to the 132 mass chain. D.R.Chick

539.163.2 : 539.166.2

3594. ON THE DECAY OF ^{132}Cs. K.S.Bhatki, R.K.Gupta and S.Jha.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1519-24 (Dec., 1956).

Gamma-rays from seven-day Cs^{132} have been studied in a scintillation spectrometer with a large well-type NaI crystal. In addition to the 670 keV γ-ray, 1080 keV, 1200 keV and 1300 keV γ-rays have been observed. From the sum peaks, levels in Xe^{132} at 670 keV, 1440 keV, 1960 keV and 2200 keV are inferred. From the sum peak areas, the intensities of electron capture to different levels have been estimated. A tentative decay scheme has been suggested. A.

539.163.2

3595. DECAY SCHEME OF Pt^{199}. J.M.LeBlanc, J.M.Cork and S.B.Burson.
Phys. Rev., Vol. 104, No. 6, 1670-3 (Dec. 15, 1956).

The radiations of the 30 min activity of Pt^{199} have been investigated with 180° magnetic photographic spectrometers and a 10-channel coincidence scintillation spectrometer. This activity of Pt has been found to decay by the emission of 4 β-rays with maximum energies of 0.8, 1.1, 1.3 and 1.7 MeV. Gamma-rays with energies of 0.074, 0.197, 0.246, 0.318, 0.475, 0.54, 0.71, 0.79 and 0.96 MeV were detected. Extensive beta–gamma and gamma–gamma coincidence measurements were made; and an energy level scheme proposed which is consistent with the results of all of the experiments. A.

539.163.2

3596. DISINTEGRATION OF Ga^{70}. M.E.Bunker, J.P.Mize and J.W.Starner.
Phys. Rev., Vol. 105, No. 1, 227-31 (Jan. 1, 1957).

The radiations of Ga^{70} (21.1 min) have been investigated with beta- and gamma-scintillation spectrometers. The principal mode of decay is a ground-state beta transition of energy 1.65 ± 0.01 MeV. Study of the gamma spectrum has revealed two gamma-rays with energies and intensities (relative to the total number of disintegrations) of 1.036 ± 0.010 MeV (0.76%) and 0.174 ± 0.005 MeV (0.44%). These two gamma-rays are in coincidence. From the above facts and the results of beta–gamma coincidence studies, it is concluded that there are two weak beta-groups with energies and intensities of 0.61 ± 0.02 MeV (0.3%) and 0.44 ± 0.02 MeV (0.5%) leading from Ga^{70} to levels in Ge^{70} at 1.036 and 1.21 MeV, respectively. The angular correlation of the two gamma-rays has been measured, and the observed correlation function is in agreement with that expected for the spin sequence 0-2-0. A search for evidence of the 1.21 MeV electric-monopole crossover transition yielded negative results. A.

539.163.2

3597. DECAY OF Sn^{125} (9.7-DAY AND 9.4-MINUTE). S.B.Burson, J.M.LeBlanc and D.W.Martin.
Phys. Rev., Vol. 105, No. 2, 625-33 (Jan. 15, 1957).

The beta and gamma radiations of the 9.7 day and 9.4 minute radioactive decays of Sn^{125} have been studied by scintillation methods using multichannel coincidence spectrometers. Sources were prepared by thermal-neutron irradiation of metallic tin foil enriched in Sn^{124}, followed by chemical purification. In the 9.7 day activity, seven gamma-rays of energies 0.342, 0.468, 0.811, 0.904, 1.068, 1.41 and 1.97 MeV are observed. Their intensities, expressed in % of the total decay to excited states, are 9, 10, 20, 18, 73, 3 and 24 respectively. The presence of four beta-ray components is deduced; their energies are 2.35, 1.28, 0.47 and 0.38 MeV, with log ft values of 8.9, 9.8, 7.9 and 7.7 respectively. There is a possible weak fifth component of 0.94 MeV with log ft about 10.4. The coincidence data define a decay scheme involving excited states in Sb^{125} at 1.07, 1.41, 1.88 and 1.97 MeV, with the strong (~ 95%) 2.35 MeV

beta-ray proceeding directly to the ground state. All these excited states surely have spins of at least 9/2, and all probably have positive parity. In the 9.4 min decay, four gamma-rays of 0.326, 0.64, 1.07 and 1.39 MeV are observed. Their intensities, expressed in % of the total decay, are 99.7, 0.3, 0.3, and 1.9 respectively. The first and last are coincident, and define an excited level at 1.72 MeV. The principal beta component of 2.05 MeV proceeds to the intermediate level at 0.326 MeV. The beta component to the 1.72 MeV level has therefore an energy of 0.66 MeV and log ft of 5.8, so the level has a low spin and probably positive parity. The two weak gamma-rays are also found to be in coincidence, with an energy sum of 1.72 MeV. The intermediate state of this cascade could be at either 1.07 or 0.64 MeV. Since it must be of fairly low spin, it apparently cannot be identical with the 1.07 MeV level observed in the 9.7 day decay. A.

539.163.2 : 539.152.1

$\gamma-\gamma$ CORRELATION OF γ-RAYS FROM Gd^{154}. See Abstr. 3532

539.164

3598. ALPHA-DECAY. L.L.Gol'din, L.K.Peker and G.I.Novikova. Uspekhi fiz. Nauk, Vol. 59, No. 3, 459-541 (1956). In Russian.

Among topics discussed are the following: experimental technique, $\alpha-\gamma$ correlations, the classical theory of α-decay, α-decay to the ground level of a daughter nucleus, non-sphericity of nuclei and the rotational structure of excitation levels, rotational levels and the fine structure of α-rays, the intensity of lines in an α-spectrum, easy and difficult transitions. There are 31 pages of tables of α-radioactive isotopes (up to 1 April 1956) giving method of decay, half-life, energy, energy of γ-radiation, $\alpha-\gamma$ and $\gamma-\gamma$ coincidences, decay type, basic character of the nucleus. 280 refs. C.R.S.Manders

539.164 : 539.152.1

3599. ALPHA-DECAY OF Pu^{240}. L.N.Kondrat'ev, G.I.Novikova, Yu.P.Sobolev and L.L.Gol'din.
Zh. éksper. teor. Fiz., Vol. 31, No. 5(11), 771-4 (1956). In Russian.

Results of investigation of the α-spectrum of Pu^{240} using an α-spectrometer are described. The α-spectra and level scheme of the U^{236} nucleus are presented. The parameters of the 4+ level were determined with greater precision than previously; an α-line corresponding to transition to the 6+ level has been detected for the first time and the parameters of this level were measured. Two weak lines have been detected which can be attributed to α-decay of Pu^{240}. The experimental values for the intensity of the 0+, 2+, 4+ and 6+ levels are compared with Landau's theoretical formula. A.

539.164.08 : 537.542

3600. ALPHA-GAMMA COINCIDENCE COUNTING FOR FLOW-COUNTER CALIBRATION. W.S Lyon and S.A.Reynolds.
Nucleonics, Vol. 14, No. 12, 44, 46, 48 (Dec., 1956).

The absolute calibration of 4π α-counters using Am^{241} sources by measurement of the coincidences with the 60 keV γ-ray. R.D.Smith

539.165 : 539.152.1

3601. ON THE PROBLEM OF THE SYSTEMATIZATION OF β-SPECTRA. R.Seidl.
Czech. J. Phys., Vol. 6, No. 2, 199-200 (April, 1956). In Russian.

Review of nuclear behaviour deduced from β-spectra. W.O.Lock

539.165

3602. STUDY OF A LOW INTENSITY COMPONENT IN THE β-RAY SPECTRUM OF $^{214}_{83}Bi$(RaC). G.R.Bishop and F.Demichelis.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1599-600 (Dec., 1956).

The existence of a 2.56 MeV β-particle from RaC, in a 6% transition to the first excited state of RaC', is confirmed by the β-ray pulse-height spectrum in a plastic phosphor and by coincidences between the β-rays and the 0.606 MeV γ-ray from RaC'. D.R.Chick

539.165 : 537.533.8

3603. CLASSICAL MODEL OF K CAPTURE INNER BREMSSTRAHLUNG. R.G.Winter.
Amer. J. Phys., Vol. 25, No. 2, 79-80 (Feb., 1957).

As a classical model for radiative capture, a current loop that has initially a moment of one Bohr magneton and that decays with a mean life of $\hbar$ divided by the transition energy is considered. The shape of the low-energy end of the spectrum and the total number of photons produced per capture are given correctly. A.

539.165

3604. THE RATIO OF K-CAPTURE TO POSITRON EMISSION IN FLUORINE 18. R.W.P.Drever, A.Moljk and J.Scobie.
Phil. Mag. (Eighth Ser.), Vol. 1, 942-8 (Oct., 1956).

The existence of electron capture in the decay of F^{18} has been revealed by the detection of K-radiations of oxygen in a proportional tube spectrometer containing a gaseous BF_3 source. The K/β^+ ratio determined from the number of counts in the observed K-peak and the total number in the positron spectrum is 0.030, with an estimated accuracy of 6%. A scintillation spectrometer investigation showed the absence of any gamma-rays with intensity greater than 0.5% of the positrons, suggesting that both K-capture and beta decay are ground state to ground state transitions. A comparison between theoretical and measured values of the K/β^+ ratio gives, for the ratio of the axial vector and tensor coupling constants, $C_A/C_T = (0.4 \pm 2)\%$. A.

539.165

3605. ELECTRON–NEUTRINO ANGULAR CORRELATION IN THE BETA DECAY OF NEON-19. M.L.Good and E.J.Lauer.
Phys. Rev., Vol. 105, No. 1, 213-16 (Jan. 1, 1957).

The distribution in kinetic energy of the recoil ions associated with beta-rays of known energy in the beta-decay of Ne^{19} has been measured. For the coefficient λ in the theoretical distribution in the cosine of the angle between the outgoing electron and neutrino, $[1 + \lambda(v/c)\cos\theta]$, a value of $\lambda = +0.14 \pm 0.13$ is found, suggesting that the Fermi component of the beta-decay interaction is scalar. A.

539.165

3606. ELECTRON–NEUTRINO ANGULAR CORRELATION IN THE BETA DECAY OF Ne^{19}. W.P.Alford and D.R.Hamilton.
Phys. Rev., Vol. 105, No. 2, 673-8 (Jan. 15, 1957).

The electron–neutrino angular correlation coefficient α has been determined in the beta decay of Ne^{19} by observing the spectrum of positrons coincident with nuclear recoils emitted approximately antiparallel to the positrons. The source region in the volume containing the Ne^{19} activity was defined by a retarding grid system and by the requirement that coincident recoils from the source exhibit the correct delay relative to the positrons. Negatively charged recoils were detected in a silver–magnesium alloy electron multiplier, which was also found to be fairly sensitive to uncharged recoils in the energy range below 200 eV. Positron energies were determined with a crystal-photomultiplier spectrometer and multichannel analyser. Comparison of the measurements with calculated spectra yields a value of $\alpha = -0.15 \pm 0.2$, confirming earlier conclusions that the beta interactions has the form ST(P) rather than VT(P). Earlier measurements on the recoil spectrum using this apparatus had given $\alpha = -0.8 \pm 0.4$. The difference between this value and the present measurements was found to be due to uncertainties in circuit timing which have small effects on the electron spectrum but much larger effects on the spectrum of recoils. A.

539.165

3607. INTERNAL BREMSSTRAHLUNG FROM Pr^{143} AND Pm^{147}. N.Starfelt and J.Cederlund.
Phys. Rev., Vol. 105, No. 1, 241-6 (Jan. 1, 1957).

A NaI(Tl) scintillation spectrometer was used for the study of the spectral distribution of the internal bremsstrahlung from the beta emitters Pr^{143} ($E_{\beta max}$ = 922 keV) and Pm^{147} ($E_{\beta max}$ = 226 keV). Both the shape of the corrected experimental spectra and the total yield of internal bremsstrahlung measured per beta decay disagree with the original Knipp–Uhlenbeck theory and with the improved version of this theory, which takes into account the nuclear Coulomb field. For Pr^{143} the measured bremsstrahlung yield exceeds that of the Knipp–Uhlenbeck theory by factors of 1.58 (1.48) and 2.56 (1.50) at 50 and 500 keV, respectively. The numbers in parentheses refer to the Coulomb-corrected theory. The corresponding factors for Pm^{147} are 1.58 (1.37) and 6.1 (2.45) at 25 and 150 keV, respectively. A.

539.165.08

3608. ABSOLUTE STANDARDIZATION OF BETA-EMITTING ISOTOPES WITH A LIQUID SCINTILLATION COUNTER. J.Steyn.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 865-7 (Nov., 1956).

Solution of β-active specimens in the liquid phosphor of a scintillation counter is shown to lead to accurate and rapid source standardization. The method was tested using I^{131}, P^{32} and Co^{60} and agreement with other methods was obtained to about 1%. M.A.Grace

539.166

3609. ON THE ENERGY SPECTRUM OF THE γ-RADIATION EMITTED BY THE FISSION PRODUCTS OF U^{235}. E.Germagnoli and L.Mongini.
Energia nucleare, Vol. 3, No. 1, 32-8 (Feb. 15, 1956). In Italian.

The energy distribution of the γ-rays emitted from the fission products of uranium and its compounds, irradiated in the JEEP reactor, have been examined using a scintillation counter and a single-channel pulse-analyser. Graphs are given showing the γ-ray spectra from NaU_2O_7 and uranium metal, at various times after irradiation, and for different periods of irradiation. P.Rothwell

539.166

3610. MAGNETIC AND SCINTILLATION SPECTROMETERS; THE CASE OF THE γ-RAYS OF $^{228}_{90}Th$ AND ITS DECAY PRODUCTS. B.Chinaglia and F.Demichelis.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1160-4 (Nov., 1956).

The γ-spectrum of $_{90}Th^{228}$ in equilibrium with its decay products was investigated by means of a scintillation spectrometer, and particularly the γ-spectrum of $_{84}Po^{212}$. The results are in agreement with those of other authors. The reliability of the results is discussed. These are compared with those obtained by means of a magnetic spectrometer. A.

539.166

3611. γ-RADIATION FOLLOWING PROTON CAPTURE IN ^{35}Cl, ^{37}Cl AND ^{39}K. J.H.Towle, R.Berenbaum and J.H.Matthews.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 84-90 (Jan., 1957).

The excitation functions of the reactions $Cl(p,\gamma)A$ and $K^{39}(p,\gamma)Ca^{40}$ in the region 0.8-1.8 MeV have been obtained using targets of natural isotopic composition. At the prominent resonances measurements with a NaI scintillation spectrometer have yielded information on the decay schemes of A^{38}, A^{38} and Ca^{40}. The yield of the more intense γ-rays has been measured. Bound levels have been located in A^{36} at 1.95 ± 0.05 and 4.1 ± 0.1 MeV. A.

539.166.08

3612. CORRECTING ANTHRACENE DOSIMETER READINGS FOR NEUTRON RESPONSE. K.R.Spearman, Jr.
Nucleonics, Vol. 14, No. 11, 84-6 (Nov., 1956).

The light output of an anthracene crystal (1 in. height and $1\frac{1}{2}$ in. diameter) was determined as a function of energy of monokinetic neutrons ($\frac{1}{2}$-4) MeV from the $T(p,n)He^3$ reaction. The results can be used to estimate the correction necessary to anthracene gamma-ray dosimeters used in the presence of fast neutrons. R.D.Smith

539.166.08 : 537.531.08

COINCIDENCE ARRANGEMENT FOR THE DETECTION OF LOW ENERGY QUANTA. See Abstr. 3343

539.166.74

3613. COMPTON EFFECT ON AN EXTENDED ELECTRON. V.S.Barashenkov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 694-5 (1956). In Russian.

It is claimed that introduction of a form-factor into the interaction term in field theory destroys the gauge invariance, and hence allows emission of scalar and longitudinal gamma-rays. The effect of this on Compton scattering at high energies is calculated. G.E.Brown

539.166.83

3614. ON THE ENERGY OF THE 570 keV γ-RAY OF Bi^{207}. G.Bäckström.
Ark. Fys., Vol. 10, Paper 29, 393-5 (1956).

Using a double focusing magnetic spectrometer, the K-conversion line was observed at $B\rho = 2838.9 \pm 0.4$ gauss cm, corresponding to a γ-ray energy of 569.7 ± 0.1 keV. The ThC'' L-line was used as reference line. The ThC'' M-line was also observed, having $B\rho = 2891.9 \pm 0.5$ gauss cm. J.J.Wilkins

539.166.835

3615. ABSOLUTE PAIR PRODUCTION CROSS SECTION OF LEAD AT 2.76 MeV. S.Standil and R.D.Moore.
Canad. J. Phys., Vol. 34, No. 11, 1126-33 (Nov., 1956).

A collimated beam of 2.76 MeV Na^{24} gamma-rays was made to fall on a specially constructed target and the positrons produced in the target were detected by counting two-quanta annihilation events by means of two scintillation spectrometers in coincidence. The strength of the Na^{24} source was measured by a coincidence counting technique and the counter detection efficiency for annihilation radiation was measured with a calibrated Na^{22} source. The effect of absorption of the 0.511 MeV annihilation radiation in the target was measured in a separate experiment. The value obtained for the cross-section was 2.38 ± 0.62 barns. A.

539.166.835

3616. MOMENTUM DISTRIBUTION OF METALLIC ELECTRONS BY POSITRON ANNIHILATION. A.T.Stewart.
Canad. J. Phys., Vol. 35, No. 2, 168-83 (Feb., 1957).

The angular correlation of photons from the two-photon decay of positrons has been measured for positrons annihilating in some 34 elements, mostly metals. These data give the momentum distribution of photons and hence of the centre of mass of the annihilating electron-positron pairs. The momentum distributions are discussed in terms of the velocity dependence of the annihilation probability. It is concluded that the observed momentum distributions are primarily the momentum distributions of the conduction electrons in the metals. A higher momentum component is observed, which is attributed to ion core effects. A.

539.166.835

3617. POSITRON DECAY IN SOLUTIONS OF ALKALI METALS IN AMINE TYPE SOLVENTS. B.G.Hogg, T.H.Sutherland, D.A.L.Paul and J.W.Hodgins.
J. chem. Phys., Vol. 25, No. 5, 1082-3 (Nov., 1956).

A delayed coincidence technique was used to measure the positron decay of a Na^{22} Cl source in ammonia, ethylenediamine, ammonia containing sodium and ethylene-diamine containing sodium or potassium. The results suggest that metal-amine solutions of high metal content behave towards the positron in the same manner as the metal itself. M.Ebert

NUCLEAR REACTIONS 539.17

539.172

3618. DURATION OF ATOMIC COLLISIONS. O.Oldenberg.
Amer. J. Phys., Vol. 25, No. 2, 94-7 (Feb., 1957).

The conventional estimate of the duration of an atomic collision is the time required to cover an atomic diameter or, if there is a force of attraction, the period of one molecular vibration. Whereas this estimate is adequate for the duration of a head-on collision, it fails for eccentric collisions. These are described by "effective potential curves" which were originally introduced to represent dissociation of diatomic molecules by rotation and take into account the centrifugal force. These curves, different from the ordinary potential curves, show broad maxima outside of the well-known minima. The maxima slow down or even repel the approaching atoms. A pair of atoms whose energy carries it just to the top of a maximum may even perform a part of an unstable rotation. In the general case of eccentric collisions the durations cover a wide range between the period of a molecular vibration and the much longer period of a molecular rotation. A.

539.172

3619. ANGULAR CORRELATION FOR THE $(a,b\gamma)$ TYPE NUCLEAR REACTION. A.A.Kraus, Jr, J.P.Schiffer, F.W.Prosser, Jr and L.C.Biedenharn.
Phys. Rev., Vol. 104, No. 6, 1667-9 (Dec. 15, 1956).

The angular correlation for nuclear reactions of the cascade type, $(a,b\gamma)$, has been calculated. Various specializations are given, and the coherence of interference terms discussed. A.

539.172

3620. SOME CRITERIA FOR A POWER PRODUCING THERMONUCLEAR REACTOR. J.D.Lawson.
Proc. Phys. Soc. B, Vol. 70, Pt 1, 2-10 (Jan., 1957).

Calculations of the power balance in thermonuclear reactors operating under various idealized conditions are given. Two classes of reactor are considered: first self-sustaining systems in which the charged reaction products are trapped and, secondly, pulsed systems in which all the reaction products escape so that energy must be supplied continuously during the pulse. It is found that not only must the temperature be sufficiently high, but also the reaction must be sustained long enough for a definite fraction of the fuel to be burnt. A.

539.172 : 537.525

3621. CONTROLLED FUSION RESEARCH — AN APPLICATION OF THE PHYSICS OF HIGH TEMPERATURE PLASMAS. R.F.Post.
Rev. mod. Phys., Vol. 28, No. 3, 338-62 (July, 1956).

Reviews authoritatively, but in general terms, the problems of obtaining energy in a controllable fashion from the nuclear reactions of light elements. Solution of the problems could supply all the

energy needed by mankind for 10^{12} years at the present rate. The most promising reactions are those of deuterium and tritium leading to the synthesis of He^4, which combine large energy yield with the minimum Coulomb repulsion between the nuclei. The reaction cross-sections are near to the maximum at energies of 10^4-10^5 eV, whereas the energy yield per reaction is several MeV. Consequently the problem of achieving a controlled thermo-nuclear reactor is that of heating a mass of deuterium and/or tritium to about 10^8 °K, and confining the mass at that temperature for sufficient time for the energy released to exceed that spent in heating the fuel. At such temperatures, the fuel will be completely ionized, and must be confined by electromagnetic fields. Data, formulae and discussions on the following topics are given: binary reaction rates for D–D and D–T reactions; energy loss from radiation, and the need to prevent thermal conduction losses; confinement of the plasma by the pinch effect; instabilities of a pinched gas discharge; physical phenomena in an ionized gas, particularly collision processes and relaxation times; particle motions in crossed electric and magnetic fields; experimental methods of studying plasmas; scaling laws; fruitless approaches. R.S.Pease

539.172

3622. ENERGY DEPENDENCE OF FISSION WIDTHS. V.G.Nosov.
Zh. éksper. teor. Fiz., Vol. 31, No.2(8), 335-6 (1956). In Russian.

The energy dependence of fission widths just above threshold is discussed and shown to be non-monotonic. W.O.Lock

539.172 : 537.525

PINCHED GAS DISCHARGES IN THERMONUCLEAR REACTORS. See Abstr. 3327

539.172 : 539.18

3623. INTERACTION OF 5×10^9 - 5×10^{10} eV COSMIC-RAY PARTICLES WITH Be NUCLEI. I. N.G.Birger, N.L.Grigorov, V.V.Guseva, G.B.Zhdanov, S.A.Slavatinskiĭ and G.M.Stashkov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 971-81 (1956). In Russian.

Meson production by 5×10^9 - 5×10^{10} eV cosmic-ray particles was studied in a cloud chamber containing a 9.8 g/cm² Be plate under conditions closely approaching nucleon–nucleon interaction. 11 interaction events involving the formation of four or more secondary charged particles are analysed in detail. The angular distribution of π-mesons and nucleons in the centre-of-mass system of the two colliding nucleons and also the distribution of the primary particle energy among the secondary particles was obtained for these events. A.

539.172 : 539.18

3624. ANALYSIS OF THE MESON-CREATION EVENTS BY COSMIC-RAY PARTICLES. II. N.G.Birger, V.V.Guseva, K.Kotel'nikov, V.M.Maksimenko, C.V.Ryabikov, S.A.Slavatinskiĭ and G.M.Stashkov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 982-6 (1956). In Russian.

For Pt I, see preceding abstract. Three events are described of meson creation by cosmic-ray particles whose momenta were measured by magnetic deflection in an arrangement consisting of two cloud chambers. The analysis confirms the existence of a large spread in the number of secondary particles and the energy transferred to the π-meson. A.

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172 : 539.18

3625. INTERACTION OF NEGATIVE π-MESONS WITH CARBON AND LEAD NUCLEI AT 230-250 MeV. V.P.Dzhelepov, V.G.Ivanov M.S.Kozodaev, V.T.Osipenkov, N.I.Petrov and V.A.Rusakov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 923-31 (1956). In Russian.

The interaction of 230-250 MeV negative π-mesons with carbon and lead nuclei was studied in a cloud chamber in a magnetic field. The total and differential π-meson elastic scattering cross-sections, and also the total cross-section for all inelastic interaction processes, were determined. Within the experimental errors, elastic scattering was found to agree with what one would expect from diffraction scattering on an opaque nucleus. Measurements of the energy spectrum of scattered π-mesons showed that inelastic scattering in the angle interval 60° to 180° occurs chiefly as a result of single scattering of the impinging π-mesons by separate nucleons in the nucleus. A.

539.172

3626. GENERATION OF γ-QUANTA IN THE COLLISION OF CHARGED FAST π-MESONS WITH NUCLEI. A.G.Sitenko.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1119-22 (1956). In Russian.

Diffraction radiation of γ-quanta in the collision of charged π-mesons with nuclei is investigated. The Coulomb interaction of the mesons with the charge of the nuclei is taken into account and it is shown that the contribution of this interaction becomes particularly important in the case of semitransparent nuclei. G.Martelli

539.172

3627. INELASTICITY IN COLLISIONS BETWEEN PIONS AND LEAD NUCLEI. M.Cresti, W.D.B.Greening, L.Guerriero, A.Loria, G.Zago and M.Deutschmann.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 747-57 (Oct., 1956).

From direct measurements of the energy of charged pions (from 0.5 to 5 GeV) interacting with Pb nuclei, and of the energy of the neutral pions produced in these interactions, the fraction of the primary energy radiated as π^0-mesons is shown to be 0.17 ± 0.04; from this follows a mean inelasticity $\bar{\gamma} \cong 0.5$. The data show that low and high values of γ are preferred, with a minimum at intermediate values. A.

539.172

3628. MEAN EXCITATION ENERGY OF THE URANIUM ATOM UNDERGOING FISSION BY ABSORPTION OF SLOW π-MESONS. N.S.Ivanova.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 693-4 (1956). In Russian.

Comparison of data for fission by slow mesons with that by 140 MeV protons leads to a mean excitation energy for the former case lying between 50 and 80 MeV. G.E.Brown

539.172

3629. INELASTIC AND ELASTIC SCATTERING OF 187-MeV ELECTRONS FROM SELECTED EVEN-EVEN NUCLEI. R.H.Helm.
Phys. Rev., Vol. 104, No. 5, 1466-75 (Dec. 1, 1956).

A survey has been made of the differential scattering cross-sections for 187 MeV electrons on the even-even nuclei $_{12}Mg^{24}$, $_{14}Si^{28}$, $_{16}S^{32}$, $_{18}A^{40}$ and $_{38}Sr^{88}$. It has been possible to separate the elastic scattering from the inelastic in all cases and to resolve the inelastic groups from specific nuclear levels for at least one level in all cases. A simple Born-approximation analysis of the elastic data yields values of the effective radii and surface thicknesses of the nuclear charge densities which (if suitably corrected for failure of the Born approximation) are in substantial agreement with the results of Hahn, Ravenhall and Hofstadter; i.e. a radius parameter of $c \cong 1.08\ A^{1/3} \times 10^{-13}$ cm (radius to half-maximum of the charge distribution) and a surface thickness of $t \cong 2.5 \times 10^{-13}$ cm (thickness from 10% to 90% of the maximum of the charge distribution). Phenomenological analysis of the inelastic scattering along the lines laid down by Schiff yields some tentative multipolarity assignments, and application of some results of Ravenhall yields estimates of (radiative) partial level widths; for the E2 transitions these correspond to lifetimes of $\sim 19 \times 10^{-13}$ sec (Mg 1.37 MeV) to $\sim 1.4 \times 10^{13}$ sec (Sr 1.85 MeV). The observed strengths of the transitions are compared to those predicted by Weisskopf theory. A.

539.172.1

3630. NEW NUCLEAR REACTIONS INDUCED BY 2-MeV LITHIUM IONS; THE MASSES OF B^{13} AND C^{15}. E.Norbeck,Jr.
Phys. Rev., Vol. 105, No. 1, 204-9 (Jan. 1, 1957).

A lithium ion source has been developed which can be used in a standard 2 MeV van de Graaff generator, producing a focused beam of 1-2 microamperes of magnetically separated Li^7. Above 1.4 MeV the beam produced disintegration particles from lithium targets, and above 1.8 MeV disintegrations from beryllium were observed. The reaction $Li^7(Li^7,p)B^{13}$ was studied by observing the protons at 90° from the lithium beam. The Q value is 5.97 ± 0.05 MeV and the M-A of B^{13} is 20.39 ± 0.05 MeV, corresponding to a physical atomic weight of 13.021 90 ± 0.000 05. The cross-section for the ejection of B^{13} protons into unit solid angle at 90° rises monotonically and exponentially from 1.2 to 22 microbarns between 1.4 and 2.0 MeV bombarding energy. Three groups of protons from the reaction $Li^6(Li^7,p)B^{12}$ were identified, and the two of lesser energy corresponded well with the known excited states of B^{12} at 0.950 and 1.67 MeV. The intensities of the proton groups at 2 MeV were ground: first excited: second excited = 1 : 1.1 : 0.8. Two groups of protons were identified from the reaction $Be^9(Li^7,p)C^{15}$. The more energetic of these established the Q value of the reaction as 9.05 ± 0.05 MeV, and corresponds to an M-A of C^{15} of 14.35 ± 0.05 MeV, or a physical atomic weight of 15.015 41 ± 0.000 05. The proton group of lesser energy is 2.1 times as intense as the ground state group at 2 MeV bombarding energy and at 90° from the beam; it corresponds to an excited state of the C^{15} nucleus lying 0.70 ± 0.05 MeV above the ground state. A.

539.172.1

3631. STUDY OF SOME He^3-INDUCED REACTIONS ON C^{12}. D.A.Bromley, E.Almqvist, H.E.Gove, A.E.Litherland, E.B.Paul and A.J.Ferguson.
Phys. Rev., Vol. 105, No. 3, 957-73 (Feb. 1, 1957).

He^3 induced reactions in carbon have been studied for bombarding energies in the range 1.0 to 3.0 MeV. Absolute excitation curves have been obtained for the proton groups leading to the first three states in N^{14} and for the neutron group leading to the O^{14} ground state; these show pronounced resonance structure corresponding to levels in O^{15}. Angular distributions have been measured at seven different energies for protons and four for neutrons. These distributions are not directly explicable as resulting from either compound nucleus or direct interaction processes but do show marked structure. The threshold for the $C^{12}(He^3,n)O^{14}$ reaction had been determined to be 1449.6 ± 2.8 keV, which requires a mass defect for O^{14} of 12.146 ± 0.0065 MeV. The total cross-sections for the (He^3,n) reaction to the O^{14} ground state and for the (He^3,p) reaction to the analogue 2.3 MeV state in N^{14} are in the ratio 2 : 1, and the angular distributions for protons and neutrons from these reactions are quite similar at energies somewhat above the neutron threshold, as would be expected. The total cross-sections for the (He^3,p) reaction range from 0.03 to 25 mb at these energies. The cross-section of the $C^{12}(He^3,\alpha_0)C^{11}$ reaction has been found to be approximately an order of magnitude greater than that of the $C^{12}(He^3,n_0)O^{14}$ reaction and is suggestive of direct interaction. A.

539.172.1 : 539.164

3632. THE ALPHA-ACTIVITY INDUCED IN PLATINUM BY BOMBARDMENT WITH NITROGEN IONS. W.E.Burcham and B.C.Haywood.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 862-5 (Nov., 1956).

Isotopes of At and Po, prepared by bombardment of Pt with N^{14} ions (10^{-8} – 10^{-9}A, E_{max} = 110 MeV), were identified by their half-lives and α-particle energies. The general trend of the yields is in accord with the predictions of the evaporation model.

M.A.Grace

539.172.11/.13

3633. COULOMB EXCITATION OF BROMINE AND RHENIUM. E.A.Wolicki, L.W.Fagg and E.H.Geer.
Phys. Rev., Vol. 105, No. 1, 238-40 (Jan. 1, 1957).

Separated isotopes of bromine and rhenium have been studied by means of Coulomb excitation with 2 to 4.2 MeV protons and alpha-particles. Gamma-rays were observed with a NaI crystal spectrometer at the following energies: Br^{79}, 219; Br^{81}, 278; Re^{185}, 126, 160, and 186; Re^{187}, 135, 168, and 303 keV. Probable level schemes are given which are based on coincidence measurements and, in some cases, on excitation curves. The results from data on Ta^{181} taken in the course of this study are also included. The reduced transition probabilities for excitation of all relevant nuclear levels have been measured. In the case of Ta and the Re isotopes the cascade to crossover intensity ratio in the decay of the second excited state has also been measured. A.

539.172.13 : 539.152.1

PROTON DISTRIBUTION IN THE C^{12} (d,p)C^{13} REACTION. See Abstr. 3530

539.172.13 : 539.152.1

ENERGIES OF ALPHA-PARTICLES FROM N^{14}(d,α)C^{12}. See Abstr. 3531

539.172.13 : 539.163.1/.2

PRODUCTION OF C^{15} BY THE C^{14}(d,p)C^{15} REACTION. See Abstr. 3587

539.172.13

3634. SPALLATION YIELDS FROM HIGH ENERGY PROTON BOMBARDMENT OF HEAVY ELEMENTS. J.D.Jackson.
Canad. J. Phys., Vol. 35, No. 1, 21-37 (Jan., 1957).

Monte Carlo calculations for the prompt nuclear processes occurring upon bombardment of heavy elements by 400 MeV protons are combined with a description of the subsequent neutron evaporation to determine spallation cross-sections for comparison with experiment. The model employed is a schematic one which suppresses the detailed characteristics of individual nuclei, but gives the over-all behaviour to be expected. Many-particle and collective effects such as alpha-particle emission and fission are ignored. The computed cross-sections are presented in a variety of different graphical forms which illustrate quantitatively the qualitative picture of high energy reactions first given by Serber (1947). The calculations are in general agreement with existing data when fission is not an important effect, but the agreement does not imply a very stringent test of the various features of the model. A.

539.172.13

3635. THE ANGULAR DISTRIBUTION AND YIELD OF THE REACTION $F^{19}(p,\alpha_0)O^{16}$. R.L.Clarke and E.B.Paul.
Canad. J. Phys., Vol. 35, No. 2, 155-67 (Feb., 1957).

The yield of the ground state alpha-particles from this reaction has been studied from an energy of 1.3 MeV to 2.7 MeV. The observed angular distributions were analysed in terms of a Legendre polynomial expansion by the method of least squares. Six resonances were found in the energy region studied, at bombarding energies of 1.358 MeV, 1.709 MeV, 1.853 MeV, 2.11 MeV, 2.31 MeV and 2.58 MeV. The widths and peak cross-sections of these resonances are respectively: (54 ± 10 keV., 46 ± 5 mb), (140 ± 5 keV., 55 ± 6 mb), (132 ± 5 keV., 77 ± 8 mb), (75 ± 25 keV., 10 ± 2 mb), (80 ± 25 keV., 32 ± 5 mb), and (300 ± 25 keV., 51 ± 10 mb). Their spins, parities, channel spin mixtures, and partial widths are discussed. A.

539.172.13

3636. ELASTIC SCATTERING OF 20-MeV PROTONS BY OXYGEN AND NITROGEN. R.H.Chow and B.T.Wright.
Canad. J. Phys., Vol. 35, No. 2, 184-94 (Feb., 1957).

The absolute angular distributions for 20 MeV protons elastically scattered by O^{16} and N^{14} were determined using the external beam of the frequency-modulated cyclotron. The distributions for the two elements were found to be similar except for the appearance of a more pronounced first minimum in the O^{16} distribution. The locations of the maxima and minima seem to indicate that simple diffraction effect is responsible for their presence. The cross-sections range from about 1 barn per sterad. to 4 mB per sterad. between 15° and 165° in the laboratory system. The standard deviations due to statistics range from 1½ to 10%. A.

539.172.13

3637. RADIATIVE CAPTURE OF PROTONS OF LESS THAN 1 MeV IN BERYLLIUM. A.B.Clegg.
Phil. Mag. (Eighth Ser.), Vol. 1, 1116-25 (Dec., 1956).

The radiative capture of protons of less than 1 MeV in beryllium has been studied by a number of authors; there is some disagreement on the number of resonances involved. This paper describes some investigations of the gamma-rays produced by the radiative capture of protons in beryllium, which show that their yield for protons of less than 1 MeV is due to two broad resonances; any other resonances are are weak. One of these resonances, at 995 keV, is well known; the gamma-radiation from the other, at 330 keV, has been investigated in detail in the present work. A.

539.172.13

3638. INELASTIC SCATTERING OF PROTONS BY C^{12}. C.P.Browne and J.R.Lamarsh.
Phys. Rev., Vol. 104, No. 4, 1099-101 (Nov. 15, 1956).

The yield of inelastically scattered protons from the first excited state of C^{12} was measured as a function of bombarding energy from 5.3 to 7.3 MeV. The angular distribution of these protons was also measured at 6.13, 6.51,and 6.90 MeV. The absolute cross-section was obtained by comparison with the known (d,p) cross-section. The results indicate that, in this energy range, this inelastic scattering process proceeds largely by way of compound-nucleus formation, which obscures any direct interaction effects that may be present. A.

539.172.13

3639. REACTION $N^{14}(p,p'\gamma)N^{14}$. J.K.Bair, H.O.Cohn, J.D.Kington and H.B.Willard.
Phys. Rev., Vol. 104, No. 6, 1595-7 (Dec. 15, 1956).

The yield of the 2.31 MeV gamma-rays resulting from the inelastic scattering of protons by N^{14}, leaving the residual nucleus in its first excited state, has been measured for bomarding energies ranging from 2.5 to 5.1 MeV. Four levels were found at energies of excitation in the compound nucleus O^{15} of 11.00, 11.08, 11.83, and 11.91 MeV, having experimental widths of 90, 25, 80, and 70 keV, respectively. Angular distributions of the gamma-rays taken at the resonances were isotropic, in agreement with the previous assignment of spin 0 to the 2.31 MeV state in N^{14}. A.

539.172.13

3640. RADIATIVE PROTON CAPTURE BY C^{13}. H.B.Willard, J.K.Bair, H.O.Cohn and J.D.Kington.
Phys. Rev., Vol. 105, No. 1, 202-4 (Jan. 1, 1957).

A new resonance in the yield of the $C^{13}(p,\gamma)N^{14}$ reaction has been observed at E_p = 3.11 ± 0.01 MeV with a total width of 30 ± 3 keV and a peak cross-section of 0.70 ± 0.14 millibarn for the ground state transition. An assignment of 2^- has been made for this 10.43 MeV level in N^{14} which results from the capture of d-wave protons and decays mainly by electric dipole radiation to the ground state. This result is inferred from the observed angular correlation of $W(\theta)$ = $1-(0.40 \pm 0.02)P_2(\cos\theta)$ and the large radiation width of 17 eV. It is most probably a T = 1 state. There is about a 10% cascade through the 6.44 MeV level of N^{14}. A.

539.172.13

3641. DIFFERENTIAL CROSS SECTION MEASUREMENTS FOR THE ELASTIC SCATTERING OF PROTONS BY N^{14}. C.R.Bolmgren, G.D.Freier, J.G.Likely and K.F.Famularo.
Phys. Rev., Vol. 105, No. 1, 210-12 (Jan. 1, 1957).

The differential cross-section has been measured in the energy range from 1.5 to 3.5 MeV at scattering angles of 39°14', 54°44', 90°, 125°16', and 140°46' in the centre-of-mass coordinate system. The probable error in the values of the cross-section is about 4 to 5%. Pronounced anomalies in the cross-section occur at laboratory proton energies of 1.55, 1.74, 1.805, 2.36, 2.49, 3.20, and anomalies in the cross-section occur at laboratory proton energies of 1.55, 1.74, 1.805, 2.36, 2.49, 3.20, and 3.40 MeV, with a probable error in these energies of 0.01 MeV. The anomaly at 3.40 MeV indicates a previously unreported level in O^{15*} at about 10.5 MeV. The magnitude of the off-resonance cross-section at 140°46' is about four times, at 125°16' about three times, and at 90° about two times that which would result from pure Rutherford scattering. At 54°44' the off-resonance cross-section differs from the Rutherford cross-section over most of the energy range by less than 5%, while at 30°14' the cross-section is generally 10 to 20% below the Rutherford cross-section. A.

539.172.13

3642. ELASTIC SCATTERING OF PROTONS BY N^{14}.
F.B.Hagedorn, F.S.Mozer, T.S.Webb, W.A.Fowler and C.C.Lauritsen.
Phys. Rev., Vol. 105, No. 1, 219-26 (Jan. 1, 1957).

The cross-section for the elastic scattering of protons by N^{14} has been measured at centre-of-mass angles of 90°, 125°, 154° and 160° for proton energies between 620 and 1820 keV. Anomalies were observed at 1054 ± 3, 1544 ± 6, 1737 ± 4 and 1799 ± 5 keV. If one assumes that the nonresonant cross-section results from only s-wave potential scattering, the assignments $J = 3/2^+$ at 1054 keV and $J = 1/2^+$ at 1544 keV are deduced. Fitting of the 1737 keV anomaly has not been found possible if one assumes a pure s-wave background. This uncertainty in background also prevents a definitive analysis of the 1799 keV data. However, qualitative theoretical fits of the 1799 keV data are obtained for p-wave formation of either a $J = 1/2^-$ or $3/2^-$ state. A.

539.172.13

3643. (p,n) REACTIONS IN Mn^{55}, Co^{59}, Zn^{67}, AND Zn^{68}.
R.A.Chapman and J.C.Slattery.
Phys. Rev., Vol. 105, No. 2, 633-8 (Jan. 15, 1957).

The counter ratio technique has been applied to the study of these. The ground state thresholds were found at proton energies of 1.895 ± 0.005 MeV for Co^{59}, 3.762 ± 0.005 MeV for Zn^{68}, and 1.805 ± 0.005 MeV for Zn^{67}. Thresholds were found corresponding to excited states in Fe^{55} at 0.924, 1.327, 2.16, 2.554, 2.92 and 3.76 MeV; in Ni^{59} at 0.325, 1.195, 1.776, 2.551, 3.043, 3.543 and 3.340 MeV; in Ga^{68} at 0.188, 0.342, 0.574 and 0.848 MeV; and in Ga^{67} at 0.357, 0.85 and 1.54 MeV. Absolute cross-sections were measured for neutrons at 0° to the incident beam. A.

539.172.13

3644. INELASTIC PROTON SCATTERING FROM GOLD AT 6 MeV. B.Elbek and C.K.Bockelman.
Phys. Rev., Vol. 105, No. 2, 657-61 (Jan. 15, 1957).

Inelastically scattered protons from a thin gold target, corresponding to Coulomb excitation of the 545, 279, and 268 keV levels in Au^{197}, have been observed in a magnetic spectrograph. The angular distribution of the inelastic groups seems to follow the semiclassical theory. A.

539.172.13

3645. REACTION $N^{15}(p,\gamma)O^{16}$. D.H.Wilkinson and S.D.Bloom.
Phys. Rev., Vol. 105, No. 2, 683-5 (Jan. 15, 1957).

The reaction $N^{15}(p,\gamma)O^{16}$ has been studied up to a proton energy of 4 MeV by using a gas target and NaI(Tl) detectors. Above the well-known resonance at a proton energy of 1.05 MeV where the peak cross-section is 1 mb, the cross-section drops to a minimum of about 8 μb around a proton energy of 3 MeV and then increases slightly towards the higher energies. There are no pronounced new resonances and in particular the cross-section up to a proton energy of about 3 MeV can be largely accounted for in terms of the high-energy tail of the 1.05 MeV resonance. There is no sign of the very strong quadrupole emission which earlier results on the inverse photodisintegration reaction had led one to expect near a proton energy of 2.8 MeV with a peak cross-section of about 90 μb. Over the whole range of proton energy the gamma-ray emission is isotropic to within about 10%, and this suggests that the 13.09 MeV state of O^{16} (the 1.05 MeV resonance) is well-described as $p^{-1}2s$ and probably contains less than 3% in intensity of $p^{-1}d$. A.

539.172.13

3646. SCATTERING OF NUCLEONS BY NUCLEI IN THE 30-MeV REGION. L.R.B.Elton and L.C.Gomes.
Phys. Rev., Vol. 105, No. 3, 1027-33 (Feb. 1, 1957).

The experimental results on the inelastic scattering of 31 MeV protons by medium and heavy nuclei cannot be explained by compound nucleus processes. It is shown here that neither can they be explained by knock-on scattering taking place throughout the nuclear volume, since most of the protons that enter the nucleus are trapped into a compound nucleus by total internal reflection at the nuclear boundary. Good agreement with experiment is obtained on the assumption that the scattering is very largely due to target nucleons that can be treated as momentarily free in the extreme diffuse rim of the nucleus. A.

539.172.13

3647. NUCLEAR CROSS SECTIONS FOR 900 MeV PROTONS.
N.E.Booth, B.Ledley, D.Walker and D.H.White.
Proc. Phys. Soc. A, Vol. 70, Pt 3, 209-18 (March, 1957).

The cross-sections of carbon, aluminium, copper, antimony and lead for 900 MeV protons have been measured. Observations were made with a counter telescope in which the final counter subtended a number of different angles at the absorber. Extrapolation of "poor-geometry" results gave the inelastic cross-sections. Extrapolations for nuclear cross-sections, which require "good-geometry" measurements, were possible only for the lighter elements carbon, aluminium and copper because of Coulomb scattering. If the nuclear radius R is assumed to follow the form $R = r_0 A^{1/3}$, the value $r_0 = (1.26 \pm 0.03) \times 10^{-13}$ cm is obtained. If the tapered nuclear density distribution of Williams (Abstr. 7378-9/1955) is assumed, a radial parameter of 0.73×10^{-13} cm is obtained. A.

539.172.13

3648. HEAVY NUCLEAR FRAGMENTS FROM DISINTEGRATIONS PRODUCED BY FAST PROTONS IN NUCLEAR EMULSIONS.
O.V.Lozhkin and N.A.Perfilov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 913-22 (1956). In Russian.

Fine-grained P—9 nuclear emulsions were used to study the interaction of 350-660 MeV protons with emulsion nuclei involving the formation of multiply charged particles with $Z \geq 4$. The formation of multiply charged high-energy particles (E_{kin} per nucleon > 3-4 MeV) was found to occur in interactions with light (C,N,O) as well as heavy (Ag,Br) emulsion nuclei. The main features of the nuclear disintegrations containing fragments have been investigated. The analysis indicates that in order to explain fragment production a number of assumptions regarding the existence of some specific properties of the primary interaction between fast protons and n nuclei must be made. A.

539.172.13

3649. NUCLEAR DISINTEGRATIONS PRODUCED BY 660 MeV PROTONS IN PHOTOGRAPHIC EMULSIONS. E.L.Grigor'ev and L.P.Solev'eva.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 932-8 (1956). In Russian.

Experimental data on nuclear disintegrations produced by 660 MeV protons in photographic emulsions are presented. The general nature of the disintegrations, magnitude of the inelastic cross-section, energy and angular distributions of the secondary protons and α-particles are presented. The yield of π-mesons per disintegration is given and an approximate value for the lower limit of the cross-section for emission of two charged π-mesons in a disintegration is indicated. A.

539.172.13 : 537.591.8

NUCLEAR INTERACTIONS DUE TO COSMIC-RAY PROTONS. See Abstr. 3423

539.172.13 : 539.152.1

THE $Na^{23}(p,p')Na^{23*}$ REACTION. See Abstr. 3539

539.172.13

3650. ISOTOPIC-SPIN SELECTION RULE VIOLATION IN THE $O^{16}(d,\alpha)N^{14}$ REACTION. C.P.Browne.
Phys. Rev., Vol. 104, No. 6, 1598-1602 (Dec. 15, 1956).

The $O^{16}(d,\alpha)N^{14}$ reaction has been observed to proceed to the first excited state of N^{14} in violation of the isotopic-spin selection rule. The yields of this alpha group and the alpha groups leading to the ground state and second excited state have been measured from 5.5.to 7.5 MeV bombarding energy. At 7.03 MeV, the angular distributions of the three groups have been measured from 15 to 130°. An absolute cross-section has been obtained by comparison with the known proton elastic scattering from O^{16}. The observed isotopic-spin selection rule violation is of the order of magnitude predicted by theory on the basis of Coulomb-force mixing of states of different isotopic spin. A.

539.172.13

3651. ELASTIC SCATTERING OF DEUTERONS BY O^{16}. D.W.Berger and O.J.Loper.
Phys. Rev., Vol. 104, No. 6, 1603-5 (Dec. 15, 1956).

Thin targets of silicon dioxide on Formvar were bombarded with deuterons in order to study the yield of deuterons elastically scattered from O^{16}. The incident deuteron energy was varied in approximately 20 keV steps from 4.6 to 7.2 MeV for observations at 130°, and from 4.6 to 7.0 MeV for observations at 90°. The absolute cross-section was determined by comparisons with the known O^{16} elastic proton cross-section. The yield shows resonant structure; in particular, at least eight maxima occur at 130°, and five of these appear at 90°. The resonances are not isolated but indicate overlapping levels. A.

539.172.13

3652. LOW-ENERGY SPECTRA IN THE Be^9 + d REACTIONS. R.W.Gelinas and S.S.Hanna.
Phys. Rev., Vol. 104, No. 6, 1681-3 (Dec. 15, 1956).

The Be^9 + d reactions have been studied in the region of the alpha continua arising from many-particle disintegrations. A search was made especially for alpha and triton groups; no evidence was found for a state in Li^7 at 5.5 MeV or for one in Be^8 at 4.1 MeV. A.

539.172.13

3653. DEUTERON-INDUCED REACTIONS FROM N^{14}, N^{15}, AND He^4. E.K.Warburton and J.N.McGruer.
Phys. Rev., Vol. 105, No. 2, 639-47 (Jan. 15, 1957).

A study has been made of the reactions $N^{14}(d,p)N^{15}$, $N^{14}(d,t)N^{13}$, $N^{15}(d,p)N^{16}$, $N^{15}(d,\alpha)C^{13}$, and $He^4(d,p)He^5$ using 14.8 MeV deuterons. Angular distributions and stripping reduced widths were obtained for five proton groups leading to energy levels in N^{15}. The stripping reduced widths for the first two negative parity levels of N^{15} were used to gain information concerning the N^{14} ground state wave-function. The absolute differential cross-sections obtained for the $N^{14}(d,t)N^{13}$ reaction were compared to theoretical predictions. Nine proton groups observed from the $N^{15}(d,p)N^{16}$ reaction were assigned to levels in N^{16} at 0, 0.126 ± 0.015, 0.303 ±0.009, 0.403 ± 0.015, 3.980 ± 0.02, 4.80 ± 0.05,5.25 ± 0.05, and possibly at 3.53 ± 0.03 and 5.01 ± 0.05 MeV. Angular distributions were obtained for the first four levels, which have been previously reported. The four angular distributions yielded l = 2, 0, 2, 0 and "reduced widths" of $(2J+1)\Theta^2$ = 0.27, 0.19, 0.33, 0.54 for the 0, 0.12, 0.30, and 0.40 MeV levels, respectively. The results of the angular distributions were combined with theoretical predictions to give most probable values of $J^\pi = 2^-$, 0^-, 3^-, and 1^-, respectively. Ten alpha-particle groups were observed from the $N^{15}(d,\alpha)C^{13}$ reaction corresponding to previously reported C^{13} levels. The stripping reduced width obtained for the $He^4(d,p)He^5$ ground state reaction was Θ^2 = 0.05, and the centre-of-mass half-width of the He^5 ground state was measured to be 0.55 ± 0.030 MeV. A.

539.172.13

3654. SOME ASPECTS OF THE STRIPPING REACTIONS. M. El Nadi.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 62-7 (Jan., 1957).

The Born approximation method for calculating the stripping cross-section is applied to the (d,α) reactions, in which it is assumed that the incident deuteron picks up a proton and a neutron from the target nucleus. The angular distribution shows a peak in the forward direction. Agreement between theory and experimental curves is satisfactory. A.

539.172.13

3655. A STUDY OF THE REACTION $^{12}C(d,p)^{13}C$. N.Sarma, M.Govindjee and H.R.Allan.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 68-77 (Jan., 1957).

Yields and angular distributions for the reaction $C^{12}(d,p)C^{13}$ have been studied for deuteron bombarding energies between 800 keV and 1.7 MeV. It is shown that the reaction proceeds, at these energies, almost entirely through the formation of a compound nucleus, and not by a stripping process. Assignments of quantum numbers to the resonance levels observed in the compound nucleus are suggested. A.

539.172.13

3656. AN INVESTIGATION OF THE REACTIONS $^{12}C(d,n)^{13}N$ AND $^{28}Si(d,n)^{29}P$. J.M.Calvert, A.A.Jaffe and E.E.Maslin.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 78-83 (Jan., 1957).

The angular distributions of several neutron groups from stripping of deuterons on targets of C^{12} and Si^{28} have been measured, and compared with theoretical curves. The parity and possible spin of the final state have been determined for those cases showing a "stripping distribution". Absolute cross-sections for formation of the final states were measured, and from these the reduced widths were determined for several levels in the final nuclei N^{13} and P^{29}. A.

539.172.13

3657. THEORY OF THE STRIPPING REACTION. A.G.Sitenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 636-41 (1956). In Russian.

A simple deduction of Butler's formula for the angular distribution in the (d,p) reaction is presented. Scattering of the deuteron and proton waves in the nuclear field is taken into account. In the limiting case of high incident deuteron energy the theory leads to the results obtained by Serber. A.

539.172.13

3658. INVESTIGATION OF THE $Be^9(d,n)B^{10}$ NUCLEAR REACTION. V.I.Mamasakhlisov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 652-6 (1956). In Russian.

The reaction between a beryllium nucleus and a deuteron, in which the latter is captured by the nucleus and the odd beryllium neutron is expelled, has been investigated. The effective cross-section for the process and the angular distribution of the emitted neutrons have been determined. Satisfactory agreement between the angular distribution and experimental data is observed for small angles up to 70°. A.

539.172.13 : 539.152.1

STUDY OF THE $Al^{27}(d,p)Al^{28}$ AND $B^{10,11}(d,p)B^{11,12}$ REACTIONS. See Abstr. 3533

539.172.3

3659. ENERGY AND ANGULAR DISTRIBUTIONS OF PHOTOPROTONS PRODUCED BY 70 MeV X-RAYS. W.K.Dawson.
Canad. J. Phys., Vol. 34, No. 12B, 1480-96 (Dec., 1956).

Thin foils of aluminium, copper, rhodium, and gold were bombarded with the X-ray beam from the 70 MeV synchrotron. The resulting photoprotons were detected by means of 200μ Ilford C-2 emulsions in a moving-plate camera which enables energy distributions up to about 16 MeV and angular distributions from 20 to 160° with respect to the X-ray beam to be determined. At least 3500 tracks from each of aluminium, copper, and rhodium and about 2000 tracks from gold were measured. The experimental energy distributions have been compared to evaporation theory with a nuclear temperature independent of excitation energy and a photoelectric formula varying as $E^{-7/2}$. The evaporated component of the observed photoproton energy distributions can be fitted with constant nuclear temperatures of 2.1, 1.1 and 1.0 MeV for aluminium, copper and rhodium respectively. It has not been possible to give an interpretation of the energy distribution of photoprotons from gold. The angular distribution of photoprotons of energies greater than 8 MeV from aluminium shows a pronounced forward asymmetry while those of lesser energy, as well as photoprotons of all observed energies from copper, appear to have isotropic angular distributions. Higher energy photoprotons from rhodium ($E_p > 7$ MeV) and gold ($E_p > 11$ MeV) have angular distributions which are well represented by $I(\theta) = a + b(\sin\theta + p\sin\theta\cos\theta)^2$. This angular distribution is attributed to interference between electric dipole and electric quadrupole absorption. A.

539.172.3

3660. PHOTODISINTEGRATION OF DEUTERONS AT HIGH ENERGIES. D.R.Dixon and K.C.Bandtel.
Phys. Rev., Vol. 104, No. 6, 1730-5 (Dec. 15, 1956).

Photodisintegration of deuterons has been investigated by use of the photon beam from the 342 MeV synchrotron at Berkeley. A liquid deuterium target was used. Protons were detected with a telescope consisting of either twelve or thirteen scintillation counters. The height of the pulse from one of the first counters and the number of subsequent pulses served to identify the protons and determine their energy. Differential cross-sections were determined at laboratory angles of 36°, 49°, 75°, 106° and 141° and at energies ranging from 136 MeV to 293 MeV, and curves of the form $d\sigma/d\Omega' = A + B\cos\theta' + C\cos^2\theta'$ were fitted to the experimental points at various energies. Total cross-sections in the region of 70 μb were obtained. A comparison with the results of similar experiments at other laboratories indicates that beam monitoring is within 10% agreement in absolute value between the Berkeley synchrotron and other synchrotrons. A method is described for experimentally measuring the nuclear attenuation correction inherent in range counters, rather than calculating the correction. A.

539.172.3

3661. ON THE PHOTODISINTEGRATION OF $^{209}Bi_{83}$. A.Hanson, F.Ferrero, R.Malvano and C.Tribuno.
R.C.Accad. Naz. Lincei, Vol. 20, No. 3, 362-5 (March, 1956). In Italian.

A graph is given of the total cross-section of the (γ,n) reaction

as a function of energy in the range 12 to 30 MeV. The angular distribution has the form $0.61 + 0.39 \sin^2\theta$ at 30 MeV in essential agreement with lower energy measurements. J.Hughes

539.172.3

3662. DIFFRACTION SCATTERING OF HIGH-ENERGY PHOTONS BY NUCLEI. V.B.Berestetskiĭ and E.V.Kuznetsov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 723 (1956). In Russian.

The cross-section is found by methods analogous to those used in the optical model for nuclei. This is found to be smaller for heavy nuclei than that for scattering by the Coulomb field, but it is concentrated more in the forward direction. G.E.Brown

539.172.4

3663. STUDY OF THE NUCLEAR REACTION $Al^{27}(n,p)Mg^{27}$ WITH NEUTRONS OF 14 MeV. Y.Oshima.
Ann. Soc. Sci. Bruxelles I, Vol. 70, 73-9 (1956). In French.

The angular distribution of the protons leaving Mg^{27} in the ground state has been studied with nuclear emulsions. The results are qualitatively similar to those predicted by a direct interaction theory (Abstr. 1729/1953), but there is a discrepancy in the angular-momentum change which has to be put into the theory. The angular distributions for inelastically scattered neutrons were also measured. J.M.Cassels

539.172.4 : 539.152.1

3664. LECTURES ON THE THEORY OF NEUTRON SCATTERING. I-IV. D.M.Brink.
Atomic Energy Res. Establ. (Harwell) Lecture NP/L1, 17 pp. (1956).

An account of four lectures given at Harwell in November 1955. Two models of the nucleus are investigated with the same result in each case. J.Thewlis

539.172.4

3665. THE NEUTRON CAPTURE CROSS SECTIONS OF Pu^{238}, Pu^{242}, AND Am^{243} IN THE THERMAL AND EPICADMIUM REGIONS.
J.P.Butler, M.Lounsbury and J.S.Merritt.
Canad. J. Phys., Vol. 35, No. 2, 147-54 (Feb., 1957).

Thermal neutron capture cross-sections of 403 ± 8 barns for Pu^{238}, 18.6 ± 0.8 barns for Pu^{242}, and 73.6 ± 1.8 barns for Am^{243} have been measured by the activation method assuming 36.4 barns for the thermal neutron cross-section of Co^{59}. Samples of plutonium (90% Pu^{242} + 10% Pu^{238}) were irradiated for 1 to 5 months in the NRX reactor. The growth of Pu^{239}, Am^{243} (the daughter of the 5 hr Pu^{243}), and Cm^{244} (the daughter of the 25 min Am^{244}) was determined by mass analysis and by alpha-spectrum analysis and total alpha-counting. Resonance capture integrals (from 0.5 eV to ∞) of 3260 ± 280 barns for Pu^{238}, 1275 ± 30 barns for Pu^{242}, and 2290 ± 50 barns for Am^{243} were found using cobalt and U^{238} as standards. Values of 48.6 barns and 282 barns were taken as the resonance integrals of Co^{59} and U^{238} respectively. The fission cross-section of Pu^{242} was zero within experimental error. A.

539.172.4

3666. TWO PROBLEMS IN THE THEORY OF THE SLOWING DOWN OF NEUTRONS BY COLLISIONS WITH ATOMIC NUCLEI.
N.Svartholm.
Chalmers Tekn. Högsk. Handl., No. 164, 15 pp. (1955).

The problems considered are: (1) energy dependence of the collision number for a constant neutron source, for the case where the elastic scattering cross-section is constant and the capture cross-section is inversely proportional to the neutron velocity; (2) the time and energy dependence of the neutron density or collision number after the sudden cessation of neutron production. A.O.Stanesby

539.172.4

3667. NEUTRON RESONANCES IN THE keV REGION: HEAVIER ODD ELEMENTS. H.W.Newson, J.H.Gibbons, H.Marshak, R.M.Williamson, R.C.Mobley, J.R.Patterson and P.F.Nichols.
Phys. Rev., Vol. 105, No. 1, 198-201 (Jan. 1, 1957).

The neutron total cross-sections have been measured as functions of energy for thallium (0.1-80), yttrium (6-80), rubidium (5-25), copper (1-80), and chlorine (6-200); peaks are observed which appear to be due to single resonances (energy range of the measurements in keV). Lanthanum (1-10) and yttrium (0.5-10) show peaks which may be due to single resonances. Lanthanum (10-100), praseodymium (0.5-150), gallium (1-60), gold (1-40), tantalum (1-6), silver (2.5-11), niobium (0.5-10.5), caesium (1-4.5), and iodine (1-15) show flat or wavy cross-section curves which are typical of spectra so poorly resolved that no single resonances are observed. Failure to observe even the strongest single resonance in any of these elements is consistent with a roughly exponential distribution of reduced widths. Useful averaged cross-sections are tabulated for some of the latter elements. A.

539.172.4

3668. THERMAL-NEUTRON COHERENT SCATTERING AMPLITUDES OF THALLIUM AND OSMIUM. L.Heaton and S.S.Sidhu.
Phys. Rev., Vol. 105, No. 1, 216-18 (Jan. 1, 1957).

The value of coherent scattering amplitudes, coherent cross-sections, and scattering cross-sections for bound nucleus for thallium and osmium are given. A.

539.172.4

3669. NEUTRON TRANSMISSION MEASUREMENTS AND RESONANCE PARAMETERS IN Cd. F.B.Simpson and R.G.Fluharty.
Phys. Rev., Vol. 105, No. 2, 616-19 (Jan. 15, 1957).

Neutron transmission measurements for cadmium have been determined from 14.5 eV to 11 keV. These data were taken with 0.04 to 0.07 μsec/m resolution using the Materials Testing Reactor fast chopper. Isotopic assignments have been made to those resonances which are due to Cd^{111} and Cd^{113} by using a sample enriched in Cd^{111} and another sample depleted in Cd^{113}. Breit–Wigner parameters have been obtained up to 215 eV and give values for $\overline{\Gamma}_n^0/D$ of $(0.33 \pm 0.09) \times 10^{-4}$ for Cd^{111} and $(0.43 \pm 0.13) \times 10^{-4}$ for Cd^{113}. A.

539.172.4

3670. NEUTRON RESONANCE STRUCTURE OF URANIUM-233.
L.M.Bollinger, R.E.Coté, D.A.Dahlberg and G.E.Thomas.
Phys. Rev., Vol. 105, No. 2, 661-5 (Jan. 15, 1957).

Modifications in the Argonne fast-neutron chopper and its installation at the reactor CP-5 are described. With this system, neutron transmissions of very pure samples of U^{238} were measured. Parameters for the resonances observed were obtained by a refined wing shape analysis as well as by the conventional area analysis. A previously unobserved level having a smaller reduced neutron width than any heretofore reported was detected at 10.2 eV; it is interpreted as being a p-wave resonance. Average parameters of significance to nuclear theory are deduced. For reactor application, the resonance capture integral is calculated from the parameters and is found to be in excellent agreement with the directly measured value. A.

539.172.4

3671. THE AVERAGE NEUTRON TOTAL CROSS SECTIONS OF HEAVY ELEMENTS AT LOW ENERGY. D.B.Gayther and K.P.Nicholson.
Proc. Phys. Soc. A, Vol. 70, Pt 1, 51-61 (Jan., 1957).

A method is developed for determining the total cross-section averaged over many resonances of an element from a direct measurement of the average transmission of a thick sample. This is used to obtain the average total cross-sections of fourteen elements at energies from 1 to 30 keV from transmission measurements made with the Harwell Fast Chopper. Values of the potential scattering cross-section and the ratio of average neutron width of level spacing are also obtained. The variations of these quantities with atomic weight are compared with the predictions of the strong and weak coupling models of the nucleus developed by Weisskopf et al. The fluctuations which are observed near atomic weight 150 are in qualitative agreemnnt with the weak-coupling theory provided the nuclear radius is $1.45 A^{1/3} \times 10^{-13}$ cm. A.

539.172.4

3672. PROTONS FROM THE INTERACTION OF 14 MeV NEUTRONS WITH MEDIUM WEIGHT NUCLEI. D.L.Allan.
Proc. Phys. Soc. A, Vol. 70, Pt 3, 195-208 (March, 1957).

The energies of the protons emitted by Al^{27}, Fe^{54}, Fe^{56}, Ni^{58}, Ni^{60}, and Cu^{63} when bombarded by 14 MeV neutrons have been determined using a photographic plate method. In addition, the angular distribution of the protons emitted by Cu^{63} has been measured. The energy distribution of the protons is consistent with some of them being produced by the (n,np) reaction and others by a direct interaction. Rough cross-sections for these processes are given; in the course of the work a cross-section of 10 ± 4 millibarns has been measured for the reaction $Fe^{54}(n,2n)$. The results, generally, are in good agreement with the statistical and direct interaction theories. A.

539.172.4

3673. SCATTERING OF FAST NEUTRONS BY THE COULOMB FIELD OF THE NUCLEUS. Yu.A.Aleksandrov and I.I.Bondarenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 726-7 (1956). In Russian.

Small-angle scattering of 3 - 4 MeV reactor neutrons is carried out on Pb and Cu. The differential cross-section for Pb agrees with Schwinger's calculated results. G.E.Brown

539.172.4 : 539.155.2

USE OF THE $B^{10}(n,\alpha)Li^7$ REACTION IN ISOTOPIC ANALYSIS OF BORON HYDRIDES. See Abstr. 3563

539.172.4

3674. STUDY OF THE ORDINARY FISSION OF URANIUM BY MEANS OF PHOTOGRAPHIC EMULSIONS. J.Catalá, J.Casanova and M.de la Cuadra.
An. Real Soc. Españ. Fís. Quím., Vol. 52(A), No. 11-12, 259-66 (Nov.-Dec., 1956). In Spanish.

In C-2 plates developed at temperatures below 18°C it was easy to discriminate between tracks of fission fragments and tracks of α-particles. The sum of the ranges of the two fragments of the fission of U^{235} bombarded with thermal neutrons was found to be $24.9 \pm 2.1\,\mu$, in agreement with previous results. L.Pincherle
539.172.4

3675. ESTIMATED FISSION FRAGMENT MASSES. I.W.Hay and T.D.Newton.
Canad. J. Phys., Vol. 35, No. 2, 195-207 (Feb., 1957).

The mass excesses, M – A, of atoms in the fission fragment region have been empirically estimated by extrapolation of β-decay Q-values, using the regularities found by Way and Wood (1954). The resulting estimates of the energy release in fission may indicate the most probable charge and, roughly, the range of charge for a given mass ratio of primary fission fragments. A.
539.172.4

3676. ON TEMPERATURE FLASHES IN A MEDIUM UNDER THE ACTION OF NUCLEAR RADIATION. I.M.Lifshits.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1109–11 (1956). In Russian.

The concept of a nuclear "flash point" is introduced: it is that "temperature" (energy density) of nuclear matter at which the fission rate exceeds a certain threshold. The usefulness of the concept is demonstrated by application to the thermodynamics of nuclear reactions in stars. J.W.Gardner
539.172.4

3677. ENERGY DISTRIBUTION OF MASS-97 FISSION FRAGMENTS FROM THERMAL-NEUTRON FISSION OF URANIUM-235. B.L.Cohen, A.F.Cohen and C.D.Coley.
Phys. Rev., Vol. 104, No. 4, 1046-53 (Nov. 15, 1956).

The energy distribution was measured with a high-resolution magnetic spectrograph. The fragments originate in a thin plating of U^{235} near the centre of the graphite reactor and travel 16 ft to a wedge magnet which analyses and focuses them at the focal plane 6 ft beyond. There they are caught in an aluminium foil which, after the irradiation, is cut into strips each of which is radiochemically analysed for Zr^{97}. The $H\rho$ distribution is complicated by the large energy width which leads to overlapping of momentum distributions from successive charges. An analysis of the shapes of the $H\rho$ distributions obtained with different relative charge populations determines that the width of the energy distributions is $(11.4 \pm 0.8)\%$ corrected for broadening due to prompt neutron emission. This result is in agreement with measurements of the distributions of the number of neutrons per fission but is in sharp disagreement with the predictions of Fong's theory of the fission process. The most probable energy is 174.7 ± 2 MeV for the mass-97 fission mode, and about 164.5 ± 3 MeV for the mass-91 mode. A.
539.172.4

3678. FISSION CROSS SECTIONS OF THE URANIUM ISOTOPES, 233, 234, 236, AND 238, FOR FAST NEUTRONS. R.W.Lamphere.
Phys. Rev., Vol. 104, No. 6, 1654-60 (Dec. 15, 1956).

Fission cross-sections of U^{233} and U^{238} have been measured from 5 and 500 keV, respectively, to 3 MeV neutron energy. Results of similar measurements to 4 MeV for U^{234} and U^{236} are included. Neutrons were produced by use of a beam of monoenergetic protons from a Van de Graaff generator impinging upon a tritium gas target, for all work except the low-energy end of the U^{233} curve, where the $Li^7(p,n)Be^7$, and $V^{51}(p,n)Cr^{51}$ reactions were employed. A U^{235} fission foil was used to measure neutron flux. Measured quantities were the ratios of the fission cross-sections of other isotopes to that of U^{235}, and these ratios are believed to be accurate to about 2%. Ratios were interpreted by use of the currently-accepted curve for fission cross-section of U^{235}. The U^{233} cross-section decreases monotonically with increasing energy except for a small rise around 200 keV, and a broad maximum around 2.1 MeV. The U^{238} curve shows a long tail extending down to 0.500 MeV, as contrasted with U^{236} which drops sharply near threshold. This tail shows two plateaus at 1.2 and 1.0 MeV and one perhaps at 0.65 MeV. The cross-section rises to 0.59 barn at 3 MeV. A
539.172.4

3679. ANGULAR DISTRIBUTION OF THE FRAGMENTS IN FISSION OF URANIUM BY HIGH-ENERGY NEUTRONS. V.I.Ostroumov and N.A.Perfilov.
Zh. éksper teor. Fiz., Vol. 31, No. 4(10), 716-17 (1956). In Russian.

Plates in which uranium salt has been fixed were bombarded with neutrons produced by 680 MeV protons on beryllium. Angular distributions are obtained for various numbers of accompanying charged particles. The slight anisotropy is in qualitative agreement with that found for high-energy incident protons. G.E.Brown
539.172.4

3680. CRITICALITY CALCULATIONS BY MONTE CARLO METHODS. K.W.Morton.
Atomic Energy Res. Establ. (Harwell) Rep. T/R 1903, 44 pp. (1956).

A detailed account of the application of Monte Carlo methods to calculations of the critical size of nuclear reactors. The nature of the problem, its mathematical formulation and justification are considered and illustrated with a worked example. New ideas on methods of solution resulting in a great saving of labour are presented. R.D.Smith
539.172.4

3681. AN ANALYSIS OF POWER, TEMPERATURE AND REACTIVITY TRANSIENTS IN B.E.P.O. D.V.Wordsworth.
Atomic Energy Res. Establ. (Harwell) Rep. R/R 1980, 15 pp. (1956).

A method of calculating reactor power and temperature following a sudden increase of reactivity by withdrawal of the control rods. The experimental results for three power transients in the B.E.P.O. natural uranium graphite reactor were compared with the theory. The calculated shapes of the transients were in fair agreement with the experimental results and accurate values for the maximum power and for uranium temperatures were found. R.D.Smith
539.172.4 : 621.311.25(494)

3682. SWISS EFFORTS IN THE FIELD OF NUCLEAR ENERGY. R.Sontheim.
Bull. Assoc. Suisse Elect., Vol. 47, No. 12, 553-9 (June 9, 1956). In French.

A new reactor is under construction using natural U as fuel and heavy water as moderator. This is described and illustrated, the test programme is discussed in detail and a comparison is made with the "swimming-pool" type of reactor as regards suitability for various tasks. R.Neumann
539.172.4

3683. NUCLEAR REACTOR SIMULATOR FOR TEACHING PURPOSES. L.Orr, W.Kerr and H.J.Gomberg.
Elect. Engng, Vol. 75, No. 4, 364-7 (April, 1956).

In a controlled nuclear reactor (as for power generation) the nuclear measurements have to be correlated with the measurements of temperature, flow, etc. in order to consider reactor control, thermo-electric control and the overall dynamic behaviour of the complete system. The characteristics approximate to those of a feedback amplifier and an analytical approach, by well-known techniques, can be used. An analogue computer or reactor simulator however allows much easier study and a portable simulator based on the work of Bell and Straus (See Abstr. 630/1951) is briefly outlined. The circuit is an analogue of the thermal point-reactor equations and five neutron delay groups are included. E.D.Hart
539.172.4

3684. TRANSFER FUNCTION FOR A SMALL PERTURBATION OF A NUCLEAR REACTOR WHEN NOT IN EQUILIBRIUM. S.Barabaschi and E.Gatti.
Energia nucleare, Vol. 3, No. 2, 119-26 (April 15, 1956). In Italian.

The transfer function is first introduced for the case of an exponential power rise (constant excess reactivity ΔK) and the effect of a small change of ΔK calculated. It is shown that for a given perturbation there is a greater amplification and a greater phase change, compared with the case $\Delta K = 0$. The general case for the reactor in any dynamic condition is then considered and the result evaluated for a simplified hypothetical reactor. R.D.Smith
539.172.4 : 681.142 : 621.317.79

3685. THE APPLICATION OF ANALOGUE METHODS TO COMPUTE AND PREDICT XENON POISONING IN A HIGH-FLUX NUCLEAR REACTOR. G.J.R.MacLusky.
Proc. Instn Elect. Engrs, Paper 2338M, publ. March, 1957, 4 pp. To be republished in Vol. 104B (1957).

The process of xenon poisoning, and its relation to the operation of a high-flux nuclear reactor, are discussed. An analogue computer which gives the present value of xenon poisoning, and an associated predictor which can be used to plan future reactor operations, are described. This computer-predictor is to be used as a reactor operator's tool. A.
539.172.4

3686. TEMPERATURE COEFFICIENT OF AIRCRAFT SHIELD TEST REACTOR. J.C.Nance.
Nucleonics, Vol. 14, No. 8, 98 (Aug., 1956).

Measurements of the temperature coefficient of reactivity for two core loadings at temperatures between 32°F and 180°F. Both cores show positive coefficients at low temperatures. R.D.Smith

539.172.4

3687. FISSION-PRODUCT BULDUP IN ENRICHED THERMAL REACTORS. R.W.Deutsch.
Nucleonics, Vol. 14, No. 9, 89-91 (Sept., 1956).

The poisoning of thermal reactors due to long-lived fission products is calculated as a function of fractional U^{235} burnup. The results are expressed graphically in terms of the equivalent B^{10} absorber. R.D.Smith

539.172.4

3688. COMPACT, LOW-COST REACTOR EMPHASIZES SAFETY. A.T.Biehl, R.Fayram, R.Henley, G.A.Linenberger, H.Montgomery. R.Mainhardt, G.Newby, J.Randall, D.Sawle and J.Sherwin.
Nucleonics, Vol. 14, No. 9, 100-3 (Sept., 1956).

A design study for a thermal reactor with a core containing 600 g of U^{235} as 20% enriched UO_2 powder dispersed in solid polyethylene. The core is surrounded by a 20 cm graphite reflector and shielded with 10 cm of lead and 55 cm of water. The reactor is controlled by the movement into the core of four rods containing U^{235}. The lower portion of the core is supported by a polystyrene rod containing 100 mg/cm^3 of U^{235} which, in the event of a power surge, would melt and allow the lower half of the core to separate from the upper half. A flux of 4.5×10^6 neutrons $cm^{-2} sec^{-1}$ is obtained at the normal operating power of 100 mW (maximum power is 3 W). R.D.Smith

539.172.4

3689. HOW STRONG MUST REACTOR HOUSINGS BE TO CONTAIN Na—AIR REACTIONS. E.Hines, A.Gemant and J.K.Kelly.
Nucleonics, Vol. 14, No. 10, 38-41 (Oct., 1956).

Experimental measurements on the pressure attained by igniting a spray of hot sodium in a pressure vessel containing air or oxygen depleted air were compared with calculations. For large vessels the maximum pressure reached is about 40 lb/in^2. R.D.Smith

539.172.4

3690. SOLID METAL HYDRIDES AS REACTOR MODERATORS. H.M.McCullough and B.Kopelman.
Nucleonics, Vol. 14, No. 11, 146-53 (Nov., 1956).

A review of the chemical and physical properties of the metallic hydrides. Hydrides of cerium, zirconium, and calcium are of interest as possible moderators for nuclear reactors. Hydrides of hafnium or tantalum may be useful as neutron shielding materials. R.D.Smith

539.172.4 : 621.311.25

3691. CALDER HALL REPORT.
Nucleonics, Vol. 14, No. 12, S1-S32 (Dec., 1956).

A report on the British Nuclear Conference on the Calder Hall Nuclear Power Station held in November 1956. Engineering details are tabulated together with physical data on the nuclear reactors. Lattice constants and temperature coefficients, metallurgy of canning materials and heat transfer problems are included. Possible improvements to the design are considered. R.D.Smith

539.172.4

3692. A SERIES FOR THE F-FUNCTIONS OF SHIELDING COMPUTATIONS. F.T.Binford.
Nucleonics, Vol. 14, No. 12, 62-3 (Dec., 1956).

The series form derived involves only exponential integrals for which values are readily available. R.D.Smith

539.172.4 : 518.5

3693. AN ANALOGUE HARMONIC ANALYSER. J.Pottier.
Onde élect., Vol. 35, 847-66 (Oct., 1955). In French.

The principal use of the equipment described is the estimation of the impurity content in the graphite used in the construction of nuclear reactors. The impurities (chiefly boron) in the graphite absorb a proportion of incident neutrons, the rest being diffused by the graphite. The measurement of this absorption permits a rapid and accurate determination of the impurity content. A.Wilkinson

539.172.4

3694. A PRIORI BOUNDS FOR TEMPERATURE IN CIRCULATING FUEL REACTORS. J.Franklin and H.B.Keller.
Quart. appl. Math., Vol. 14, No. 1, 57-62 (April, 1956).

The neutron density u and temperature v in a fuel reactor satisfy certain nonlinear partial differential equations. From these equations a priori bounds for u and v are derived and then numerical bounds are found. They follow from an elementary argument based on the maximum principle for elliptic and parabolic equations. L.S.Goddard

539.172.4 : 518.5

AN ANALOGUE COMPUTER FOR NUCLEAR POWER STUDIES. See Abstr. 2911

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

3695. PARITY CONJUGATION AND HYPERFRAGMENTS. S.B.Treiman.
Phys. Rev., Vol. 104, No. 5, 1475-7 (Dec. 1, 1956).

The parity conjugation scheme proposed by Lee and Yang entails that Λ-hyperfragments should exist as parity doublets, so that a given species of hyperfragment should exhibit two distinct lifetimes, corresponding respectively to the degenerate even- and odd-parity hyperfragment state functions. Likewise there should be two distinct ratios of nonmesonic to mesonic decay. The parity exchange interaction of Λ particles and nucleons, $\Lambda_1 + n \rightleftharpoons \Lambda_2 + n$ (where Λ_1 and Λ_2 are the two members of the Λ particle parity doublet), gives rise to the possibility of interesting interference effects in hyperfragment decay. A.

539.18 : 530.145

PROPERTIES OF HEAVY NEUTRAL MESONS. See Abstr. 2986

539.18 : 537.591.8

3696. UNUSUAL COSMIC RAY EVENTS OBSERVED IN A MULTIPLATE CLOUD CHAMBER. S.Naranan, P.V.Ramanamurty, A.B.Sahiar, S.Lal and A.Subramanian.
Nuovo Cimento (Ser. 10), Vol. 4, No. 3, 651-6 (Sept., 1956).

Two events have been observed in multiplate cloud chambers in which a particle comes to rest and a charged secondary emerges from the plate with a range greater than 143 g/cm^2 of lead in one case and 185 g/cm^2 in the other. These events can be interpreted as annihilation of antiprotons or as the decay of positive K-mesons but in the latter case it would imply the existence of a new type of K-meson with mass greater than 1300 m_e. A.J.Egginton

539.18

3697. ADDENDUM TO "K-MESONS IN EMULSIONS EXPOSED TO A 6.2 GeV PROTON BEAM". J.Crussard, V.Fouché, J.Hennessy, G.Kayas, L.Leprince-Ringuet, D.Morellet and F.Renard.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1195-7 (Nov., 1956).

Modifications to the results given in a previous paper (Abstr. 5430/1956) are enumerated. The abundance ratios for K-mesons remain almost unchanged although the statistics are made considerably worse. A.J.Egginton

539.18

3698. SEARCH FOR DOUBLE STARS PRODUCED BY FAST π^- MESONS. W.F.Fry and D.C.Wold.
Phys. Rev., Vol. 104, No. 5, 1478 (Dec. 1, 1956).

Nuclear emulsions, exposed to 220 MeV π^- mesons, were searched for double stars which could be due to a π^- meson trapped in a mesonic orbit about a nuclear fragment. No fragment disintegrations were observed from 7000 fast π meson stars. A.

539.18

3699. CLOUD-CHAMBER STUDY OF THE PRODUCTION AND DECAY OF STRANGE PARTICLES. G.H.Trilling and R.B.Leighton.
Phys. Rev., Vol. 104, No. 6, 1703–10 (Dec. 15, 1956).

Out of 1242 decay events observed in a magnetic cloud-chamber array triggered on penetrating showers, a total of 54 associated V-particle pairs has been obtained. All the associations observed are consistent with the "strangeness" selection rules. A statistical analysis of the numbers of double and single events has been used to obtain rough estimates of the fractions of neutral K-particles and neutral hyperons which decay by "invisible" modes, and of the relative frequencies of occurrence of various production processes. The main uncertainties in the resulting values are discussed in detail. A.

539.18

3700. A PROBABLE EXAMPLE OF THE PRODUCTION AND DECAY OF A NEUTRAL TAU-MESON. W.A.Cooper, H.Filthuth, J.A.Newth, G.Petrucci, R.A.Salmeron and A.Zichichi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1433-44 (Dec., 1956).

A four-pronged event observed in a magnet cloud chamber is

described. It is interpreted as the decay in flight of a neutral τ-meson according to the scheme $\tau^0 \rightarrow \pi^+ + \pi^- + \pi^0$ with the subsequent decay of the π^0-meson into an electron pair and a γ-ray. The τ^0-meson is produced in carbon in a small nuclear interaction which may be a charge-exchange reaction ($K^+ + n \rightarrow \tau^0 + p$). The lifetime of the τ^0-meson is about 3×10^{-10} sec. Other possible interpretations of the event are discussed and shown to be improbable.

A.

539.18

3701. A V^0-DECAY WITH AN ELECTRON SECONDARY. C.d'Andlua, R.Armenteros, A.Astier, H.C.DeStaebler, B.P.Gregory, L.Leprince-Ringuet, F.Muller, C.Peyrou and J.H.Tinlot.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 917-21 (Oct., 1956).

Description and discussion of an anomalous V^0-decay discovered in a survey of photographs taken in a cloud chamber. A.

539.18

3702. REMARKS ON THE ANALYSIS OF τ-MESON EXPERIMENTS. N.Brene, K.H.Hansen, J.E.Hooper and M.Scharff.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1059-84 (Nov., 1956).

The results from the analysis of 75 stopped τ-meson decays, found in a stack of emulsions exposed to the Berkeley Bevatron, are discussed. Special attention is paid to the effects of the finite dimensions of the stack, and a brief analysis of the problem is given. The experimental results are compared with those from other laboratories, and the authors conclude that there is no reliable evidence that the spectrum of the π-mesons from τ-decay is in accord with either of those which have been predicted for the two lowest spin—parity combinations: 0^- and 1^+. A.

539.18

3703. ON THE Q-VALUE OF THE TAU-DECAY. G.L.Bacchella, A.Berthelot, M.di Corato, O.Goussu, R.L.Setti, M.René, D.Revel, L.Scarsi, G.Tomasini and G.Vanderhaeghe.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1529-49 (Dec., 1956).

The Q-value of the τ-decay has been determined in photographic emulsions, by a procedure which, using the joint information given by ranges and angles of the secondary particles, excludes the need of a given R—E relation known a priori. The result obtained on a statistics of 45 events is: $Q = (74.9 \pm 0.4)$ MeV. An empirical expression for the R—E relation for π-mesons valid in the velocity interval $0.27 < \beta < 0.67$ is obtained: $\log [(E/m_\pi c^2) \times 10^3] = 1.649 + 0.566 \log R_{mm} + 0.010 (\log R_{mm})^2$. The standard deviation on the energy derived from a given mean range by this relation is 0.5%.

A.

539.18

3704. CLOUD-CHAMBER STUDY OF NEGATIVE STRANGE PARTICLES. G.H.Trilling and G.Neugebauer.
Phys. Rev., Vol. 104, No. 6, 1688-94 (Dec. 15, 1956).

A detailed analysis of the decays in flight of negative K mesons and hyperons, obtained with 48 in. cloud chambers is presented. The principal results are the following: (1) Two new fully measurable τ^- events add to the already strong evidence for the existence of this particle. (2) K^- events with a single charged secondary are shown to be most consistent with the $K_{\pi 2}$ and $K_{\mu 2}$ decay modes. (3) An analysis of 7 Caltech Ξ^- events is shown to lead to a Q value of 65 ± 3 MeV, and a 50% confidence lower limit to the lifetime of 4.6×10^{-10} sec. A rough upper limit to the lifetime of 2×10^{-8} sec, based on the predictions of the strangeness theory, is obtained. Angular correlations among the Ξ^- secondaries are studied, but the statistics are insufficient to permit any significant conclusion. An additional event which is most easily interpreted as a Ξ^- decay is discussed. (4) The V^- events which are neither K^- nor Ξ^- are shown to have a lifetime less than or equal to $(1.52_{-0.25}^{+0.38}) \times 10^{-10}$ sec and a P* value, based on their transverse momentum distribution, of 197 ± 7 MeV/c. These values correspond satisfactorily with the presently known properties of the Σ^- hyperon. (5) It is estimated from a comparison of the numbers of identified Ξ^-'s and V^-'s that the fraction of Λ^0 particles which decay into charged secondaries is greater than $0.40_{-0.11}^{+0.15}$, and can, insofar as the present data are concerned, be as high as unity. All errors quoted in the above results are 50% confidence limits. A.

539.18

3705. DECAY OF CHARGED K MESONS. R.Arnowitt and W.B.Teutsch.
Phys. Rev., Vol. 105, No. 1, 285-7 (Jan. 1, 1957).

The decay is considered under the assumption of the existence of two parity-conjugate particles with zero spin. The effect of a weak parity-mixing interaction, which may be of environmental or intrinsic origin, is studied. Two limiting cases are examined. If the parity-mixing interaction is weaker than the usual decay interactions, then the θ and τ mesons will appear to have the same lifetime far from their point of production; however, near the point of production a difference in their lifetimes should be discernible. On the other hand, if the parity-mixing interaction is somewhat larger than the decay interactions, only a single lifetime would occur. Ordinary decay experiments will not serve to distinguish between the latter case and the existence of a single kind of K-meson which decays without parity conservation. A.

539.18

3706. ON THE DECAY OF $K_{\mu 3}$. S.G.Matinyan.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 529-30 (1956). In Russian.

With the help of the method developed by O.Kofoed-Hansen (Abstr. 2067/1952) and by assuming the $K_{\mu 3}$-meson to be scalar (or pseudoscalar) the decay constant and the energy spectrum of μ- and π^0-mesons produced in the decay are calculated.

G.Martelli

539.18

3707. A REGULARITY OBSERVED IN THE DECAY OF UNSTABLE PARTICLES. P.S.Isaev and V.S.Murzin.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 715 (1956). In Russian.

Most Q-values in the decay of unstable particles are nearly an integral multiple of 35.5 MeV. G.E.Brown

539.18

3708. DECAY CHARACTERISTICS AND MASSES OF POSITIVE K-MESONS PRODUCED BY THE BEVATRON. R.W.Birge, D.H.Perkins, J.R.Peterson, D.H.Stork and M.N.Whitehead.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 834-55 (Oct., 1956).

A large emulsion stack exposed to the positive K-beam at the Berkeley 6 GeV Bevatron has been used to measure the mass of the K-particles and their abundances. The masses for the decay modes $K_{\mu 2}$, $K_{\pi 2}$ and τ were obtained by measurement of the mean range of the secondaries. In addition, masses for all modes compared to the proton mass were measured by the range—momentum method. The abundances were determined by following and blob-counting secondaries. The data are:

Type	Abundances %	Primary mass (m_e)	Mass from secondary range (m_e)
τ	5.56 ± 0.41	966.3 ± 2.1	966.1 ± 0.7
τ	2.15 ± 0.47	967.7 ± 4	—
$K_{\mu 2}$	58.2 ± 3.0	967.2 ± 2.2	965.8 ± 2.4
$K_{\pi 2}$	28.9 ± 2.7	966.7 ± 2.0	962.8 ± 1.8
$K_{\mu 3}$	2.83 ± 0.95	969 ± 5	—
K_{e3}	3.23 ± 1.30	967 ± 8	—

A.

539.18

3709. ON THE MEAN LIFE TIME OF K-MESONS PRODUCED BY THE COSMIC RADIATION. L.Mezzetti and J.W.Keuffel.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1096-126 (Nov., 1956).

An experiment performed at Echo Lake (Colorado) in order to measure the mean lifetime of charged heavy mesons produced by the cosmic radiation is described. The experimental procedure consists in the electronic measurement (by means of a "chronotron") of the time lag between the occurrence of a nuclear interaction and the delayed emission of a fast charged secondary in the decay (at rest) of an unstable particle produced in the interaction. The nuclear event is detected through its penetrating secondaries by means of a large scintillation counter and a Geiger-counter hodoscope, whereas the decay secondary is detected by means of a large directional water Cherenkov counter. The experimental arrangement is described; the timing errors and the criteria used to select and classify the events are discussed. The delay distributions obtained are analysed: they can be resolved into a short-life component (lifetime $9.6 \pm 0.8 \times 10^{-9}$ sec) and a long-life component (lifetime 2.2 ± 0.2 μsec); the latter is interpreted as due to the electrons of the composite $\pi \rightarrow \mu \rightarrow e$ decay of π^+-mesons produced locally by the incident nucleons. The possibility that the short-life component is due to spurious effects of some kind is discussed and ruled out on the basis of the results of auxiliary measurements: the conclusion is that the lifetime obtained should be associated essentially with the $K_{\mu 2}$ decay mode, with a possible small admixture of $K_{\pi 2}(\theta^+)$. A rough estimate of the production ratio of such particles to positive π-mesons is made, taking into account the corresponding detection efficiencies; the value found is rather higher than those (1/30-1/70) obtained from previous cosmic-ray experiments. The lifetime obtained is compared with the recent results of other authors and the assumption of a purely exponential decay curve with an unique lifetime is discussed. A.

539.18

3710. HEAVY MESON LIFETIMES. J.Orear, G.Harris and S.Taylor.
Phys. Rev., Vol. 104, No. 5, 1463-6 (Dec. 1, 1956).

Two identical nuclear emulsion stacks were exposed at different distances to the 114 MeV Bevatron K^+-beam using the same geometry and Bevatron conditions. A comparison of the K_L to τ-meson ratios in the two stacks combined with the known lifetimes in the $K_{\pi 2}$ and $K_{\mu 2}$ gives $(1.18_{-0.28}{}^{+0.58}) \times 10^{-8}$ sec for the τ^+ lifetime. The ratio of the $K_{\pi 2}{}^+$ to the τ^+ lifetime is then 1.03 with a root-mean-square error of ±29%. Thus the τ and the $K_{\pi 2}$, which according to Dalitz-type analysis should be different particles, have the same lifetime within experimental errors. The τ and K_L lifetimes can be obtained by a second method which does not rely on any previous lifetime information. In this method the ratios of the heavy meson fluxes to the proton and pion beam fluxes are compared. The results obtained by this method are $(1.04_{-0.23}{}^{+0.42}) \times 10^{-8}$ sec for the τ^+ lifetime and $(1.11_{-0.11}{}^{+0.18}) \times 10^{-8}$ sec for the $K_L{}^+$ lifetime. Alternate τ and $K_{\mu 3}$ fluxes in the two stacks also indicate a lifetime of about 10^{-8} sec. A.

539.18

3711. LIFETIME OF THE τ^+ MESON. R.Motley and V.Fitch.
Phys. Rev., Vol. 105, No. 1, 265-6 (Jan. 1, 1957).

K^+ meson lifetime measurements by counter techniques have been extended to include the τ^+ or $K_\pi{}^+$ meson. A maximum-likelihood analysis of the data yields a mean life of $(11.7_{-0.7}{}^{+0.8}) \times 10^{-9}$ sec. The previously reported mean life of the $K_{\pi 2}{}^+$ is $(12.1_{-1.0}{}^{+1.1}) \times 10^{-9}$ sec. With 95% confidence the difference between the lifetimes of the two particles is less than 20% of their arithmetic mean. A.

539.18

3712. LIFETIMES OF τ, $K_{\mu 3}$, AND K_e DECAY MODES. T.F.Hoang, M.F.Kaplon and G.Yekutieli.
Phys. Rev., Vol. 105, No. 1, 278-84 (Jan. 1, 1957).

The proportions of the various decay modes of K^+ mesons produced by the 2.9 BeV proton beam of the Brookhaven Cosmotron have been investigated in two emulsion stacks separately exposed at different distances from the target. An analysis of the observed ratios of different decay modes has been made in order to determine the various partial lifetimes, the $K_{\mu 2}$ and $K_{\pi 2}$ lifetimes being used as a secondary standard. The results indicate that within experimental error all the partial lifetimes are consistent with a unique value. A.

539.18

3713. MEASURE OF LIFETIME OF K-MESONS. M.Ya.Balats, P.I.Lebedev and Yu.V.Obukhov.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 531-3 (1956). In Russian.

The measurements have been carried out on K-mesons occurring in cosmic radiation at sea level. During 1600 hours of effective measurements, 64 K-mesons have been detected, with the help of liquid scintillation counters and fast oscillographic recording, and their mean life has been found to be $(9.5 \pm 2.0)\ 10^{-9}$ sec. A block diagram of the apparatus and a discussion of the computations involved in the measurements are given. G.Martelli

539.18

3714. THE ANGULAR DISTRIBUTIONS IN THE HYPERON DECAYS. II. G.Morpurgo.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1222-6 (Nov., 1956).

Angular distributions in hyperon decays have been calculated in a previous paper (Abstr. 5414/1956) on the assumption of parity conservation. The present paper describes the corresponding calculations for the cases of (a) non-conservation of parity in weak interactions, and (b) a Yang–Lee parity doublet. A.J.Egginton

539.18

3715. MASSES OF IDENTIFIED POSITIVE HEAVY MESONS. J.R.Peterson.
Phys. Rev., Vol. 105, No. 2, 693-706 (Jan. 15, 1957).

The charged secondary particles from all presently known decay modes of positive K-mesons have been identified, and the masses of the primaries measured by the momentum-range method. More than 2000 K-mesons were found in a rather large stack of nuclear emulsion after its exposure, behind the strong-focusing magnetic spectrometer at the Bevatron, to a target plunged into the 6.2 BeV circulating proton beam. The mean K-meson momentum at the stack was 360 MeV/c, and the proper time of flight was 1.4×10^{-8} sec. The masses of 263 systematically selected K-mesons were measured, and the averages for the various decay modes are $M(\tau + \tau') = 966.6 \pm \pm 1.9\ m_e$, $M(K_{\pi 2}) = 966.9 \pm 2.0\ m_e$, $M(K_{\mu 2}) = 967.2 \pm 2.2\ m_e$, $M(K_{\mu 3}) = 969 \pm 5\ m_e$, $M(K_{\beta 3}) = 967 \pm 8\ m_e$. The standard errors indicated apply to the relative masses; the uncertainties on the absolute masses are slightly larger. Various corrections are described. The results are discussed in the light of recent ideas concerning heavy-meson characteristics. A.

539.18

3716. ON THE ANOMALOUS MAGNETIC MOMENT OF μ-MESONS. S.Hirokawa, H.Komori and S.Ogawa.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 736-46 (Oct., 1956).

From the analysis of the cosmic-ray bursts produced by μ-mesons, the upper limit of the magnitude of the anomalous magnetic moment of μ-mesons is estimated. As a result, the anomalous magnetic moment of μ-mesons is found to be smaller than 80% of the normal Dirac moment. A.

539.18

3717. NUCLEON RECOIL IN THE PION–NUCLEON SCATTERING. L.Fonda and I.Reina.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1399-409 (Dec., 1956).

The effect of nucleon recoil has been taken into account in the extended source theory of pion–nucleon scattering with ps–pv interaction Hamiltonian. The results on P-waves are compared with experimental data and with the results of the Chew's cut-off theory and the influence of nucleon recoil in the determination of the renormalized coupling constant is discussed. To study the influence of nucleon recoil on S-phases, the ps–pv interaction Hamiltonian had two terms added to it; these terms are bilinear in the meson field and they can be obtained from a Dyson–Foldy transformation applied to the ps–ps coupling. The effect of nucleon recoil is found to be remarkable. A.

539.18

3718. ELASTIC SCATTERING OF 78-MeV PIONS FROM COPPER. R.E.Williams, W.F.Baker and J.Rainwater.
Phys. Rev., Vol. 104, No. 6, 1695-702 (Dec. 15, 1956).

The angular distributions of 78 ± 5 MeV π^- and π^+ mesons scattered elastically from copper have been measured. The experimental results are compared with the distributions found from a range of exact optical model phase-shift calculations using a complex attractive square well potential for $r < R_0$ (where $R_0 = 1.4A^{1/3} \times 10^{-13}$ cm) and the Coulomb potential for $r > R_0$. The effect of adding to the potential a term depending upon the gradient of the nuclear density, and thereby introducing a discontinuity in the matching of logarithmic derivatives at $r = R_0$, is also explored. The optical model as well as several modified Born approximation calculations show reasonable agreement with the experimental curve in the forward direction and in the region of the first diffraction maximum. At backward angles the calculated curves show pronounced maxima and minima which do not appear experimentally, perhaps because incoherent transitions at these angles mask the true coherent distribution in the experimental measurement. A.

539.18

3719. PION–PROTON SCATTERING AT 220 MeV. J.Ashkin, J.P.Blaser, F.Feiner and M.O.Stern.
Phys. Rev., Vol. 105, No. 2, 724-8 (Jan. 15, 1957).

Pion–proton differential scattering cross-sections have been measured at 220 ± 7 MeV. Measurements were made at eight angles using scintillation counters and a liquid hydrogen target. Statistical errors range from 5 to 10%. Phase-shift analyses have been made of the data in the customary manner. No evidence for d-wave scattering has been found. A.

539.18

3720. SCATTERING OF 10-30 MeV NEGATIVE PIONS BY HYDROGEN. D.E.Nagle, R.H.Hildebrand and R.J.Plano.
Phys. Rev., Vol. 105, No. 2, 718-27 (Jan. 15, 1957).

Fifty-seven π^-–p scattering events in the energy range 10-30 MeV have been observed in a hydrogen bubble chamber. The S-wave scattering length $\frac{1}{3}\eta^{-1}(2\alpha_1 + \alpha_3) = 0.077 \pm 0.011$ is found to give the best fit to the data assuming $\alpha_{13} = \alpha_{31} = \alpha_{11} = 0$, $\alpha_{33} = 0.235\eta^3$. This result is combined with the results of other low-energy scattering experiments to give estimates of α_1 and α_3. A.

539.18 : 530.145

3721. DISPERSION RELATIONS FOR SCATTERING AND PHOTOPRODUCTION. B.L.Ioffe.
Zh. éksper. teor. Fiz., Vol. 21, No. 4(10), 583-95 (1956). In Russian.

Dispersion relations have been deduced for the following cases: scattering of π-mesons on nucleons (including scattering into small non-vanishing angles); photoproduction of π-mesons on nucleons;

scattering of nucleons and antinucleons on nucleons. The method of analysis is based on the general requirement of impossibility of propagation of signals with a velocity exceeding that of light, the S-matrix concept not being employed to prove the analytical properties of the scattering amplitude. The problem, whether the micro-causality requirement is a necessary condition for validity of the dispersion relations, is discussed and it is shown that for certain types of violation of causality the dispersion relations still hold. A.

539.18 : 537.534.74

PION–PROTON SCATTERING. See Abstr. 3369

539.18 : 539.172

π^--MESON SCATTERING ON C AND Pb. See Abstr. 3625

539.18

3722. FURTHER EVIDENCE OF C^{12} TRIPARTITION INDUCED BY K^+-MESONS. N.N.Biswas, L.Ceccarelli-Fabbrichesi, M.Ceccarelli, K.Gottstein, N.C.Varshneya and P.Waloschek.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1201-3 (Nov., 1956).

Continuing earlier measurements on K-meson interactions (Abstr. 7722/1956), two events were found in nuclear emulsion stacks which are identified as $K^+ + C^{12} \rightarrow K^+ + 3He^4 - 7.3$ MeV. The mean free path for this reaction is estimated to be about 50 metres. M.A.Grace

539.18

3723. INTERACTIONS OF 85-MeV POSITIVE PIONS WITH DEUTERONS. K.C.Rogers and L.M.Lederman.
Phys. Rev., Vol. 105, No. 1, 247-56 (Jan. 1, 1957).

Collision processes of pions with deuterium have been observed in a diffusion cloud-chamber. The use of positive pions rendered visible all of the possible reactions at 85 MeV. Total cross-sections and angular distributions for elastic and inelastic scattering, charge exchange scattering, and absorption have been determined from 272 collisions in the deuterium gas. The results are compared with the phenomenological impulse-approximation theory. A.

539.18 : 539.166.9

3724. SEMIPHENOMENOLOGICAL THEORY OF PRODUCTION OF π-MESON PAIRS BY HIGH-ENERGY γ-RAYS.
I.Ya.Pomeranchuk.
Dokl. Akad. Nauk SSSR, Vol. 96, No. 2, 265-8 (1954). In Russian.

The π-meson wave-functions are plane waves plus diffraction-scattered waves from a black nucleus; the matrix element of the current then gives the amplitude for production. G.E.Brown

539.18 : 539.166.9

3725. PRODUCTION OF π-MESON PAIRS BY γ-RAYS IN THE CASE OF HEAVY ATOMS. I.Ya.Pomeranchuk.
Dokl. Akad. Nauk SSSR, Vol. 96, No. 3, 481-2 (1954). In Russian.

In case $mR \gg 1$, where m is the inverse of the Compton wavelength of the π-meson and R is the radius of the nucleus, the formula (see preceding abstract) describing the production can be greatly simplified. G.E.Brown

539.18 : 539.166.9

3726. PRODUCTION OF π-MESON PAIRS BY HIGH-ENERGY γ-RAYS ON NUCLEI. A.G.Sitenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 348-50 (1956). In Russian.

The influence of the Coulomb interaction is included in the calculations of Pomeranchuk (see two preceding abstracts), where π-meson pairs were produced by γ-rays and then transferred momentum to the nucleus in diffraction scattering. G.E.Brown

539.18

3727. DISPERSION RELATIONS FOR PHOTOPRODUCTION OF MESONS. E.Corinaldesi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1384-98 (Dec., 1956).

The Feynman amplitude for the reaction γ + nucleon $\rightarrow \pi$ + nucleon is simply related to a causal amplitude which satisfies dispersion relations. These are derived in the "natural" frame. The connection with the amplitudes in the centre-of-mass frame is discussed in detail. A.

539.18

3728. METHOD OF ANALYSIS OF CHARGED PION PHOTOPRODUCTION. M.J.Moravcsik.
Phys. Rev., Vol. 104, No. 5, 1451-3 (Dec. 1, 1956).

It is explained why the usual analysis of the angular distribution of charged pion photoproduction with the help of a quadratic expression of $\cos\theta$ (θ being the meson emission angle) is physically meaningless. A substitute scheme is proposed in which the angular distribution in the centre-of-mass system, multiplied by $(1 - \beta\cos\theta)^2$ (β being the meson velocity), is analysed by a quartic expression in $\cos\theta$. Such an analysis is given for several theories commonly in use. A.

539.18

3729. NEGATIVE TO POSITIVE RATIO FROM NONRELATIVISTIC THEORIES OF PION PHOTOPRODUCTION. M.J.Moravcsik.
Phys. Rev., Vol. 105, No. 1, 267-77 (Jan. 1, 1957).

A numerical evaluation of the Low theory of charged photoproduction is given in various approximations, including also non-relativistic recoil of the nucleon. Enhancement of only that part of the $(P\frac{3}{2},\frac{3}{2},M1)$ term which is due to interaction with the nucleon current gives reasonably good agreement with experimental data up to 440 MeV. The effect of recoil corrections is hardly discernable in the shape of the angular distribution. The differential cross-section is also calculated from a modified version of the theory, called the "adjusted" theory, in which the S-wave terms are taken from perturbation theory. This version of the theory gives an equally good fit to the data. The negative to positive ratio is then calculated in the various approximations. It is found that these approximations give nearly the same ratio, although the corresponding predictions of differential cross-section for the positive pion production differ greatly. This common prediction for the ratio agrees quite well with the experimental data, especially in the case of the "adjusted" theory. A.

539.18

3730. CHARGED-PION PRODUCTION IN LITHIUM. E.K.Gatchell.
Phys. Rev., Vol. 105, No. 2, 713-17 (Jan. 15, 1957).

Reports the measurement of charged-pion production cross-sections in Li^6 and Li^7. The measurements were made on 40 and 52 MeV pions emitted at 90° to a proton beam of 242 MeV energy. The results show a higher π^+/π^- ratio for Li^6 than for Li^7; this observation can be qualitatively explained by the Pauli exclusion principle. A.

539.18

3731. PION PRODUCTION BY INELASTIC SCATTERING OF ELECTRONS IN HYDROGEN. G.B.Yodh and W.K.H.Panofsky.
Phys. Rev., Vol. 105, No. 2, 731-4 (Jan. 15, 1957).

Measurements have been continued on the ratio of single-pion production yield in hydrogen by electrons to the yield by the corresponding photons. At an incident electron energy of 600 MeV, pions were detected at energies of 60, 147 and 170 MeV, emitted at 75° to the beam; and of 70 MeV at 135° to the beam. The results are expressed in terms of "the equivalent number of photons" N_e:

θ_{lab}	T_π	N_e
75°	60 MeV	0.0202 ± 0.0007
75°	147 MeV	0.0177 ± 0.0007
75°	170 MeV	0.0145 ± 0.0020
135°	70 MeV	0.0178 ± 0.0007

The results are compared with theoretical calculations and found to be in good agreement. A.

539.18

3732. STATIC MODEL FOR PRODUCTION OF STRANGE PARTICLES. D.C.Peaslee.
Phys. Rev., Vol. 105, No. 3, 1034-6 (Feb. 1, 1957).

A phenomenological model is considered where a nucleon is supposed to be "predissociated" into a virtual $(\Lambda + K)$ or $(\Sigma + K)$ combination. These components are realized in a "stripping" type collision with an incident pion. Reasonable parameters for the model are obtained from fitting to $\pi^- + p$ measurements; the value of a corresponding $\pi^+ + p$ measurement in this connection is pointed out. The "radius" of the $(\Lambda + K)$ system turns out to be of order 5×10^{-14} cm. The same model can be applied to K production in 6 BeV proton–nucleon bombardment; it yields one component of K's with an extremely strong forward–backward peaking in the centre-of-momentum system of the two nucleons. A.

539.18

3733. MESON PRODUCTION IN n-p COLLISIONS AT COSMOTRON ENERGIES. W.A.Wallenmeyer.
Phys. Rev., Vol. 105, No. 3, 1058-67 (Feb. 1, 1957).

Neutrons produced by 1.5 BeV p–C collisions within the vacuum tank of the Cosmotron, when incident upon the protons in the Brookhaven 20 atmosphere, hydrogen-filled, magnet diffusion chamber, produced a number of three-prong events. Of these events, 182 were of analysable quality and have been classified as being a result of the reactions $n + p \rightarrow p + p + \pi^-$, $\rightarrow p + p + \pi^- + \pi^0$, and $\rightarrow p + n + \pi^+ + \pi^-$ in the ratio of $(53 \pm 11) : (8 \pm 4) : (39 \pm 9)$, respectively, where the errors given are twice the statistical errors to

allow for classification uncertainties. The observed ratio of double to single meson production, though considerably lower than that which was found with the higher energy (2.2 BeV max) neutrons of the previous n-p experiment by Fowler, Shutt, Thorndike and Whittemore, is still more than twenty times as great as the ratio predicted by Fermi's statistical theory of meson production. However, the observed ratio is in good agreement with the predicted ratio of 47 : 14 : 39 obtained from the statistical model as refined by Kovacs, where consideration is given to the resonance enhancement of double meson production and to the suppression, by angular momentum and parity conservations, of the (pp–) reaction. The data show that the proton and the π^+ and also the neutron and the π^- tend to be emitted in opposite directions to each other much more frequently than do the proton and the π^- or the neutron and the π^+. This may be an argument in favour of an intermediate, excited state ($T = \frac{3}{2}, J = \frac{3}{2}$) model. There is no apparent evidence of any specific excitation energy for such a model from the data. A.

539.18

3734. MULTIPLE PRODUCTION OF PARTICLES IN NUCLEON–NUCLEON COLLISIONS AT 5.3 BeV. V.M.Maksimenko and A.I.Nikishov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 727-9 (1956). In Russian.

Probabilities of various end products are calculated by the statistical theory both including and excluding the isobar state. Experiments agree well with the former calculations. G.E.Brown

539.18 : 539.172.13

3735. PRODUCTION OF POSITIVE π-MESONS BY 660 MeV PROTONS ON NUCLEI OF VARIOUS ELEMENTS. A.G.Meshkovskiĭ, Yu.S.Pligin, Ya.Ya.Shalamov and V.A.Shebanov.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 987-92 (1956). In Russian.

The energy spectra of π^+-meson production in Li, Be, C, Al, Cu were measured at 45° to the proton beam. From these measurements the π^+-meson production cross-section $d\sigma/d\Omega$ were calculated. The spectra were found to be similar. The differential cross-sections $d^2\sigma/d\Omega\,dE$ for 158 MeV π^+-mesons were measured for Ag and Pb. The π^+-meson production cross-section was found to depend on the atomic mass of elements from Li to Pb. For Li to Al this dependence is given by $d\sigma/d\Omega = (1.17 \pm 0.05)\ A^{2/3}$. Considerable departure from this law, in the direction of decrease of π^+-meson yield, was found above Cu. A.

539.18 : 539.172

MESON PRODUCTION BY COSMIC RAYS. See Abstr. 3623-4

539.185

3736. NEUTRONS FROM THE D–D REACTIONS. L.Cranberg, A.H.Armstrong and R.L.Henkel.
Phys. Rev., Vol. 104, No. 6, 1639-42 (Dec. 15, 1956).

An investigation has been made of the neutron spectra resulting from D–D reactions for a range of incident deuteron energies of 4.75 to 7.33 MeV, using a pulsed-beam time-of-flight method. In addition to monoenergetic neutrons from the reaction $D(d,n)He^3$, a continuum of neutrons is observed corresponding to D(d,np)D. The yield of the latter reaction has been measured at about 0.5 MeV intervals at zero degrees, and at an energy of 6.3 MeV an angular distribution has been obtained for both reactions. At 6.3 MeV deuteron energy and at zero degrees the yield of the continuum for neutron energies above 0.95 MeV is 17% of the yield of monoenergetic neutrons. The yield from both reactions is strongly forward in the laboratory reference frame, and for the breakup process increases rapidly with increase in energy above threshold. A.

539.185

3737. NEUTRON PRODUCTION BY ELECTRON BOMBARDMENT OF URANIUM. G.C.Baldwin, E.R.Gaerttner and M.L.Yeater.
Phys. Rev., Vol.,104, No. 6, 1652-3 (Dec. 15, 1956).

A study has been made of the neutron yield from a natural uranium target in the 100 MeV betatron. For electron energies above 40 MeV, the neutron output is proportional to electron energy, for constant current in the betatron orbit. At lower energies, with the same current, neutron yield decreases faster than the electron energy. A.

539.185 : 538.114

3738. ON THE MULTIPLE SPIN WAVE SCATTERING OF NEUTRONS IN FERROMAGNETS. R.J.Elliott, R.D.Lowde and W.Marshall.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 939-40 (Dec. 1, 1956).

Extends an earlier discussion of the cross-sections for single spin-wave scattering (Abstr. 6533/1955) to multiple scattering processes. E.P.Wohlfarth

539.185

3739. ON THE PROBLEM OF THE SCATTERING LENGTHS OF SLOW NEUTRONS BY DEUTERONS. A.S.Davȳdov and G.F.Filippov.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 340-1 (1956). In Russian.

It is proved that between the two possible pairs of values of scattering lengths which are deduced from experiments ($\alpha: a_{3/2} = 6.2 \times 10^{-13}$ cm, $a_{1/2} = 0.8 \times 10^{-13}$ cm; $\beta: a_{3/2} = 2.4 \times 10^{-13}$ cm, $a_{1/2} = 8.3 \times 10^{-13}$ cm) only the α values may be theoretically explained in a satisfactory way. G.Martelli

539.185 : 530.145

3004 SCATTERING OF NEUTRONS BY DEUTERONS. See Abstr.

539.185 : 537.533

ELECTRON ACCELERATOR USED FOR PRODUCING NEUTRONS. See Abstr. 3346

539.185 : 539.27

TOTAL NEUTRON SCATTERING IN VITREOUS SILICA. See Abstr. 3762

539.185.08

3740. MEASUREMENT OF FAST NEUTRON TOTAL CROSS SECTIONS. L.Cranberg, R.K.Beauchamp and J.S.Levin.
Rev. sci. Instrum., Vol. 28, No. 2, 89-92 (Feb., 1957).

A system is described for measuring high resolution (e.g. 1 keV) total neutron cross-sections at high counting rate in the range above 50 keV neutron energy using as a neutron detector a thick proton recoil detector. The pulsed-beam time-of-flight technique is used to identify the neutrons of interest, which are produced in the target of an electrostatic accelerator. Energy modulation of the accelerator makes it possible to make observations at 100 energy points simultaneously. Illustrative results are given on the 585 keV resoanance in sulphur and on aluminium in the neighbourhood of 585 keV. The gain in speed of taking data over conventional systems is greater than a factor of 100. A.

STRUCTURE OF SOLIDS 539.2

539.21 : 539.163

3741. NOMOGRAM FOR RADIOACTIVITY INDUCED IN IRRADIATION. E.C.Freiling.
Nucleonics, Vol. 14, No. 8, 65 (Aug., 1956).

The relationship between total exposure, product of material present and activation cross-section, amount of material transmuted, resulting activity and the decay constant or halflife are displayed graphically. R.D.Smith

539.21

3742. HOW RADIATION AFFECTS MATERIALS: BASIC MECHANISMS. D.S.Billington.
Nucleonics, Vol. 14, No. 9, 54-7 (Sept., 1956).

A short review and bibliography of the principal mechanisms of radiation-induced changes in materials and the effects of the defects produced. R.D.Smith

539.21 : 539.172.4

3743. DAMAGING EFFECTS OF RADIATION ON SOLID REACTOR MATERIALS. J.H.Kittel.
Nucleonics, Vol. 14, No. 9, 63-5 (Sept., 1956).

A review of the available data including volume changes and decrease of thermal conductivity of graphite and changes in the strength and hardness of steels and other structural metals. R.D.Smith

539.21 : 621.315.616

3744. DAMAGING EFFECTS OF RADIATION ON PLASTICS AND ELASTOMERS. R.Harrington.
Nucleonics, Vol. 14, No. 9, 70-4 (Sept., 1956).

The effects of gamma-radiation exposures of up to 1.5×10^8 r on hardness, elasticity, elongation, tensile strength and weight are listed for 48 materials. Radiation resistance was highest for a styrene-rubber and lowest for P.T.F.E. R.D.Smith

539.21

3745. DAMAGING EFFECTS OF RADIATION ON CHEMICAL MATERIALS. J.C.Bresee, J.R.Flanary, J.H.Goode, C.D.Watson and J.S.Watson.
Nucleonics, Vol. 14, No. 9, 75-81 (Sept., 1956).

The results of γ-radiation exposures of up to 10^9 r on various materials including protective coatings, gasket materials, asphalts and tars, ion-exchange resins and aqueous solutions. R.D.Smith

539.21 : 621.315.616.9

3746. BENEFICIAL EFFECTS OF RADIATION ON POLYMERS. A.Charlesby.
Nucleonics, Vol. 14, No. 9, 82-5 (Sept., 1956).

Radiation exposure of long-chain molecules results in either cross-linking or reduction of molecular weight by fracture of chains or both. The cross-linking produced in polyethylene alters its physical proportions so that above its melting-point it has a rubber-like consistency and does not flow. Experimental results for the elastic modulus, tensile strength and dielectric strength as a function of dose are given. Other properties affected by cross-linking include the solubility: doses above a certain critical value resulting in gel formation. R.D.Smith

539.21

3747. BENEFICIAL EFFECTS OF RADIATION ON METALS. H.A.Saller.
Nucleonics, Vol. 14, No. 9, 86-8 (Sept., 1956).

A short review and bibliography of some of the radiation effects that may have practical use. These include conversion of molybdenum-uranium alloys to the γ-phase, hardening of alloys, change of properties of semiconductors and improvement of some catalytic materials. R.D.Smith

539.21 : 535.39

3748. THE OPTICAL EFFECTS OF RADIATION INDUCED ATOMIC DAMAGE IN QUARTZ. E.W.J.Mitchell and E.G.S.Paige.
Phil. Mag. (Eighth Ser.), Vol. 1, 1085-115 (Dec., 1956).

Measurements of the optical absorption of neutron-irradiated crystalline and fused quartz have been made in the wavelength range 1450-10 000 A (8.5-1.2 eV). Two absorption bands associated with atomic displacements in crystalline quartz have been found — C at 5.7 eV and E at 7.6 eV. Optical bleaching of the C-band, when illuminated with light of the wavelength absorbed, occurs when in the purest specimens. A preferential optical and thermal bleaching is observed at 5.4 eV during the early stages of the bleaching of neutron-irradiated specimens. It is suggested that this effect is associated with electron release and capture, without intermediate retrapping, by a close complementary pair of traps. The model which seems to fit the results best is that the C- and E-defects are oxygen ion vacancies and interstitial oxygen ions, which produce absorption bands after trapping electrons and holes respectively. The C- and E-bands are also found in fused quartz. Results obtained using thin specimens show that the absorption in the long wavelength tail of the absorption edge was enhanced during irradiation. The absorption limit in irradiated crystalline quartz is at 8.1 eV and is the same as that found in both unirradiated and irradiated fused quartz specimens. The extension of the tail is interpreted as arising from the formation of regions of amorphous material as a result of local melting. This is taken into account in estimating the concentration of point defects on the basis of collision theories. All the damage is annealed by heating at 950°C. A.

539.213 : 548.73

VITREOUS STATE OF CERTAIN POLYMERS. See Abstr. 2833

539.213.2 : 532.612

3749. SURFACE TENSION AND STRUCTURE OF MOLTEN GLASSES. R.Kruh.
J. chem. Phys., Vol. 25, No. 5, 1085-6 (Nov., 1956).

The positive temperature coefficient of surface tension for molten glasses is considered analagous to the increase in tension of a heated rubber filament of constant length and is thought to be the result of a structural arrangement whose entropy is decreased when it is subjected to a two dimensional extension. The success of the polymer orientation theory of rubber elasticity is thought to suggest that the positive temperature coefficient of surface tension for molten glass is due to a polymeric structure. T.C.Toye

539.217

3750. DIFFUSION OF ALUMINUM IN SINGLE CRYSTAL SILICON. R.C.Miller and A.Savage.
J. appl. Phys., Vol. 27, No. 12, 1430-2 (Dec., 1956).

The diffusion of aluminium into silicon has been reinvestigated to clear up certain discrepancies in the existing aluminium data. The diffusion constants found are in good agreement with those determined by Fuller and Ditzenberger and an order of magnitude less than those reported in another investigation. Aluminium solid solubilities in the neighbourhood of 10^{19} atoms/cm^3 have been found over the 1200 to 1400°C temperature range. These concentrations are several orders of magnitude larger than those reported in other aluminium diffusion investigations. The p–n junction penetrations and transition capacitances of the diffused samples were used to determine diffusivities and solid solubilities. A.

539.217

3751. SOLUBILITY AND DIFFUSIVITY OF GOLD, IRON AND COPPER IN SILICON. J.D.Struthers.
J. appl. Phys., Vol. 27, No. 12, 1560 (Dec., 1956).

The constants were determined with radioactive isotopes Au^{198}, Fe^{59} and Cu^{64}. The solid solubility of Cu increases from 2×10^{15} atoms/cm^3 (600°C) to 10^{18} (1400°C), of Au from 5×10^{14} (700°C) to 5×10^{16}, and of Fe from 5×10^{12} (900°C) to 10^{17}. The diffusion constant of Au $D_{Au} = 0.0011 \exp(-25\,800/RT)$ from 700 to 1300°C, $D_{Fe} = 0.0062 \exp(-20\,000/RT)$ from 900 to 1400°C, for Cu at 900°C $D = 5 \times 10^{-5}$ cm^2/sec. J.Franks

539.217

3752. SELF-DIFFUSION OF SILVER IN SILVER–PALLADIUM ALLOYS. N.H.Nachtrieb, J.Petit and J.Wehrenberg.
J. chem. Phys., Vol. 26, No. 1, 106-9 (Jan., 1957).

The self-diffusion of silver has been studied in alloys containing 0.00, 1.49, 3.69, 9.87 and 21.84 atom % palladium at four temperatures: 715.4, 799.4, 861.8 and 942.0°C. The rate decreases with increasing palladium atom fraction according to the relation: $D_{Ag} = 0.270e^{-8.20X}e^{-43\,700/RT}$. An alternative expression is $D_{Ag} = 0.270e^{-17.75Tm/T}$. Within experimental error, the activation energy is independent of palladium content. The rate of self-diffusion of silver is related to the solidus line of the silver–palladium phase diagram, and a simple corresponding states explanation is given. A.

539.217 : 548

3753. DIFFUSION OF RADIOACTIVE MAGNESIUM IN MAGNESIUM OXIDE CRYSTALS. R.Lindner and G.D.Parfitt.
J. chem. Phys., Vol. 26, No. 1, 182-5 (Jan., 1957).

The diffusion of Mg^{28} in crystal plates of MgO has been measured. Between 1400 and 1600°C the temperature function of the diffusion coefficient can be represented by the relation $D = 0.249 \exp(-79.0 \text{ kcal/RT})$ cm^2 sec^{-1}. A.

539.217

3754. DIFFUSION OF SILVER IN SILVER BROMIDE AND EVIDENCE FOR INTERSTITIALCY MIGRATION. R.J.Friauf.
Phys. Rev., Vol. 105, No. 3, 843-8 (Feb. 1, 1957).

Experimental results are presented for the diffusion of silver in silver bromide single crystals for temperatures from 140°C to the melting point. The results are obtained by the sectioning technique, using radioactive tracers. The observed diffusion coefficients fall below the values that would normally be expected from the electrical conductivity by a factor of 0.46 to 0.66. The discrepancy is ascribed to the simultaneous occurrence of two types of interstitialcy jumps, with corrections introduced for differing displacements of interstitials and tracer atoms and for correlation effects according to Bardeen and Herring. The resulting mobilities can be represented as $\mu = \mu_0 \exp(-U/kT)$ over a wide range of temperatures with $\mu_0 = 6.2 \times 10^{-3}$ and 1.57×10^{-3} cm^2/volt-sec and U = 0.078 and 0.225 eV, respectively, for collinear and noncollinear jumps. These values are in reasonable agreement with theoretical calculations for silver chloride. The diffusion coefficient is observed to fall increasingly below expected values as the temperature approaches the melting point, and as a possible explanation it is surmised that the activation energy for collinear jumps drops gradually towards zero. A comparison is made to similar results which have been reported for diffusion of silver in silver chloride. A.

539.217 : 537.311.33

DIFFUSION AND ELECTRICAL BEHAVIOUR OF ZINC IN SILICON. See Abstr. 3283

539.219

3755. TRANSPORT PROPERTIES OF DILUTE BINARY MAGNESIUM ALLOYS. E.I.Salkovitz, A.I.Schindler and E.W.Kammer.
Phys., Rev., Vol. 105, No. 3, 887-96 (Feb. 1, 1957).

Unusual lattice parameter behaviour in dilute binary magnesium alloys has been observed by Raynor and others, and has been attributed to a Brillouin zone overlap phenomenon suggested by Jones. The primary purpose of this paper is to show that if the overlap model is even only qualitatively correct, measurements of electron transport properties should be sensitive to electron overlap. Such measurements have been made on the resistivity, temperature variation of resistivity, Hall coefficient, and thermoelectric power. Monovalent and divalent additions to magnesium are found to cause the Hall coefficient and thermoelectric power to vary monotonically with composition, but trivalent and quadrivalent additions cause these measurements to go through extrema associated with the zone overlap. It is proposed that both the Hall coefficient and the thermoelectric

power may be expressed as the sum of two contributions. One contribution is directly related and therefore is linear to electron concentration. The other contribution arises essentially from everything else, particularly the perturbations upon the ion core potential when a foreign atom is introduced into the lattice. This later contribution may be obtained directly from measurements on the magnesium–cadmium system. A simple subtraction then provides the electronic contribution for the alloy under question. A band picture is invoked to qualitatively justify this approach. Finally, this paper also demonstrates that Matthiesen's rule and Linde's rule are not valid for dilute magnesium alloys. A.

539.219

3756. SOLID SOLUTION IN THE GaSb–InSb SYSTEM. J.C.Woolley, B.A.Smith and D.G.Lees. Proc. Phys. Soc. B, Vol. 69, Pt 12, 1339-43 (Dec., 1956).

GaSb–InSb alloys were produced by heating appropriate mixtures at 1000°C followed by quenching and short annealing. X-ray examination then showed the specimens to be predominantly two-phase. Prolonged annealing converted the specimens to the single phase state. Attempts were made by varying the method of preparing the initial alloys to reduce the required annealing period, but without success. R.F.S.Hearmon

539.23 : 537.311.31

ELECTRICAL RESISTANCES OF THIN METAL FILMS BEFORE AND AFTER ARTIFICIAL AGEING BY HEATING. See Abstr. 3249

539.234 : 535.51

3757. A POLARIMETRIC METHOD FOR THICKNESS CONTROL IN THE PRODUCTION OF INTERFERENCE FILTERS. A.Hermansen. K. Danske Vidensk. Selsk., mat.-fys. Medd., Vol. 30, Paper 6, 41 pp. (1955).

A description is given of a polarimetric method for controlling the thickness of the films used in producing interference filters. The measurement is made on the ellipticity of reflected plane polarized light and this permits evaluation of the thickness of the dielectric layer with an accuracy better than 10 A. Curves can be constructed for phase change and optical thickness. A small birefringence (0.005) is found for evaporated magnesium fluoride. Refractive index for rapidly evaporated magnesium fluoride is much lower in vacuum (1.28) than in air (1.365). S.Tolansky

539.234 : 535.393

EVAPORATED Al FILMS AND THEIR OPTICAL PROPERTIES. See Abstr. 3167

539.234 : 535.417

THICKNESS CONTROL OF THIN LAYERS. See Abstr. 3171

539.26

3758. X-RAY STUDY OF THE CHANGE IN Cu_3Au NEAR 600°C. B.Borie and B.E.Warren. J. appl. Phys., Vol. 27, No. 12, 1562-3 (Dec., 1956).

A preliminary experiment made to see whether any change could be detected in the diffuse short-range-order scattering from quenched samples. The degree of order is found to be higher for specimens quenched from above 600°C than for specimens quenched from below this temperature. J.Thewlis

539.27

3759. USES OF CARBON REPLICAS IN ELECTRON MICROSCOPY. D.E.Bradley. J. appl. Phys., Vol. 27, No. 12, 1399-412 (Dec., 1956).

Some of the early techniques for the preparation of carbon films and replicas for the electron microscope are compared with the method of vacuum evaporation developed by the author. The basic techniques for the production of replicas from evaporated carbon are described, and the high resolution obtainable is demonstrated and discussed. Some properties of evaporated carbon replicas are mentioned. Descriptions are given of the carbon replica method used in metallurgy and some applications are illustrated. Applications of carbon replicas in the following fields of research are also described: microbiology, biology, botany, entomology, chemistry, and industrial applications including the study of fibres. It is concluded that evaporated carbon can be used as the final replica in any multistage replica process, and that it can be applied with advantage in almost every field of research in which the electron microscope is employed. A.

539.27

3760. ELECTRON DIFFRACTION STUDY ON THIN ALLOY FILMS OF ALUMINIUM–SILVER SYSTEM. D.Watanabe. J. Phys. Soc. Japan, Vol. 11, No. 10, 1072-8 (Oct., 1956).

Thin evaporated alloy films of the aluminium–silver system, mainly of hexagonal close packed phase and cubic β'-phase, were examined by electron diffraction. In the evaporated films, the h.c.p. lattice with an axial ratio of 1.63 was apt to be produced, which seemed to arise from the change of (111) stacking in the f.c.c. lattice, especially when the evaporation was carried out on to substrates at elevated temperatures, while the β'-phase was in general difficult to form by evaporation only. The processes were also examined, through which the evaporated alloy films ultimately attained the equilibrium state after successive heat-treatments. A.

539.27

3761. A NEW VACUUM PLATE-CAMERA OF LARGE CAPACITY. L.N.D.Lucas and P.B.Sewell. J. sci.Instrum., Vol. 33, No. 12, 465-7 (Dec., 1956).

A multiple-plate vacuum camera for use in vertical-column type electron optical apparatus is described. The camera incorporates a new method of plate storage and selection which is very reliable in operation and makes large capacity and good pumping characteristics compatible with small volume. Design details are given for a camera of 4 litres free volume with a capacity of up to twenty-four $3\frac{1}{4}$ x $4\frac{1}{4}$ in. photographic plates. A.

539.27 : 539.185

3762. TOTAL NEUTRON SCATTERING IN VITREOUS SILICA. R.J.Breen, R.M.Delaney, P.J.Persiani and A.H.Weber. Phys. Rev., Vol. 105, No. 2, 517-21 (Jan. 15, 1957).

The structure of Corning superpure vitreous silica glass has been investigated with neutrons. A new method of analysis using variable neutron wavelengths and the measurement of total scattering cross-sections from transmission experiments is developed and the results are compared with those from differential X-ray scattering. The total neutron scattering method permits a simple and direct structure analysis with resolution apparently superior to X-rays. The preliminary results compare well in a first approximation analysis with the basic structure model of Warren and others and in addition the neutron-determined atomic radial distribution curve exhibits some finer details than the X-ray results. Thermal inelastic scattering of neutrons was corrected for in an approximate way. A.

ELASTICITY. STRENGTH. RHEOLOGY

539.3/.8

539.31

3763. A THEORY OF ELASTIC AFTER-EFFECT. J.Kubát. Ark. Fys., Vol. 11, Paper 8, 189-92 (1956). In German.

Relaxation and primary creep are discussed in a model consisting of n independent systems in which an irreversible spontaneous change can take place. The consequences of correlation between some of the systems are investigated. J.E.Caffyn

539.32

3764. APPARATUS FOR MEASURING THE ELASTIC MODULI OF CRYSTALS. K.S.Aleksandrov and O.V.Nosikov. Akust. Zh., Vol. 2, No. 3, 244-7 (1956). In Russian.

The moduli are derived from measurements of the velocity of propagation of short ultrasonic pulses of longitudinal and transverse elastic oscillations in specimens of small dimensions. The high-frequency pulse generator triggers off the time-base of a cathode-ray tube. The pulse is divided and passes respectively through the specimen under test and through a standard length of solution of known velocity-temperature characteristics. The two parts of the pulse, after passage through the specimen and tank of liquid respectively, are combined and exhibited on the screen of the cathode-ray tube and the velocity in the specimen obtained by comparison of the transmission times in the specimen and the standard liquid. Aqueous ethyl alcohol was employed as the standard since its temperature coefficient of velocity is small. Measurements made on a single crystal of ammonium dihydrogen phosphate give good agreement with values obtained by other experiments. C.R.S.Manders

539.32 : 537.533.9

3765. EFFECT OF ELECTRON IRRADIATION ON YOUNG'S MODULUS. H.Dieckamp and A.Sosin.
J. appl. Phys., Vol. 27, No. 12, 1416–18 (Dec., 1956).

Young's modulus and internal friction measurements are reported on high-purity copper following electron bombardment. The modulus is observed to rise rapidly with electron flux reaching an early saturation followed by a slow decrease. The rapid saturation is attributed to dislocation pinning. The rate of saturation is temperature dependent in the range from -195°C to about 0°C suggesting defect migration at low temperatures. The slow decrease is attributed to a "bulk effect" due to interstitial–vacancy pairs. A.

539.32

3766. ELASTIC MODULI OF DIAMOND. H.J.McSkimin and W.L.Bond.
Phys. Rev., Vol. 105, No. 1, 116-21 (Jan. 1, 1957).

The adiabatic elastic moduli of single crystal diamond have been determined by means of ultrasonic waves in the frequency range 20-200 Mc/s. c_{12} is much lower and c_{44} much higher than respective values reported in the literature. In units of 10^{12} dynes per cm^2, the newly determined values are: $c_{11} = 10.76$; $c_{12} = 1.250$; $c_{44} = 5.758$. A critical analysis of uncertainties and a comparison with results obtained by others are made. A.

539.32.08 : 534.321.9

3767. DETERMINATION OF THE ELASTIC CONSTANTS OF OPTICAL GLASSES BY AN ULTRASONIC METHOD. J.M.Barnes and E.A.Hiedemann.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1218-21 (Nov., 1956).

The values of the elastic constants of twelve samples of optical glass commercially produced in the United States and a sample of fused silica were calculated from the results of measurements made on these samples. The method used was a combination of the ultrasonic method developed by Schaefer—Bergmann with that of Hiedemann. The accuracies of the experimentally determined values of the longitudinal and shear wave velocities were 0.13% and 2.25% respectively, while the accuracies in determining the elastic constants were 0.5% for the shear modulus, Lame's modulus, and the bulk modulus, 0.7% for Poisson's ratio, and 0.8% for Young's modulus. The values of the surface tensions of the samples were calculated using the results of the measurements and Auerbach's equation. A.

539.371 : 534.23

3768. ABSORPTION OF ULTRASONIC VIBRATIONS AS A CHARACTERISTIC OF THE ELASTIC PROPERTIES OF RUBBER. L.A.Shinyanskiĭ and V.N.Solon'ko.
Zh. tekh. Fiz., Vol. 26, No. 10, 2302 (1956). In Russian.

The absorption coefficient at 2.5 Mc/s of three rubbers of different degrees of vulcanization is plotted against relative extension. The resulting curves are discussed in terms of the kinetic theory of rubber elasticity and the crystallinity of the rubbers.
R.F.S.Hearmon

539.373

3769. THE FUNDAMENTAL SLIP PROCESS IN THE TORSION OF A CRYSTAL HAVING A SINGLE ACTIVE SLIP PLANE. A.D.Whapham and H.Wilman.
Proc. Roy. Soc. A, Vol. 237, 513-29 (Nov. 20, 1956).

The hitherto particularly obscure process of deformation of a single crystal by torsion is elucidated in the general case where the slip plane is inclined to the torsion axis. It is shown to consist primarily, in zinc crystals about 0.8 cm in diameter, of a new type of slip which will be called "flexural" rotational slip. In this slip process the slip lamellae are rotated relative to adjacent lamellae, about the common normal at any point of the interface, but with simultaneous development of pronounced saddle-like flexure. This flexure results in a variation in the amount of relative rotation of neighbouring lamellae over their interface, and also causes a cylindrical crystal to develop a rounded-triangular cross-section. Optical examination shows S-shaped (0001) slip bands about 0.05 to 0.1 mm wide. Electron diffraction shows that at the saddle-shaped (0001) cleavage face the lattice is mainly practically undistorted (apart from the macroscopic flexure) to a depth of 200 A or more, thus the slip lamellae are at least 200 A thick. An expression defining the shape the slip lamellae must take up is deduced assuming that the elastic deformation is negligible, and this gives good quantitative agreement with most regions of the observed (0001) surfaces. The very minor role of twinning in the range examined (up to 66°/cm torsion) is demonstrated by this agreement of the calculated and observed (0001) surface shape. Experiments on torsion of a model made of a hundred lead lamellae illustrate well the development of the saddle-like flexure, the rounded-triangular rod section, and the non-uniformity of rotation of the lamellae over their interface. A.

539.374

3770. THE EFFECTS OF GRAIN BOUNDARIES ON THE PLASTIC DEFORMATION OF ZINC CRYSTALS. G.B.Craig and B.Chalmers.
Canad. J. Phys., Vol. 35, No. 1, 38-47 (Jan., 1957).

The tensile plastic deformation of single-crystal and tricrystal specimens of zinc was investigated by analysis of the external change in shape of the specimens, and of the changes in X-ray diffraction patterns. It was demonstrated that the single crystals deformed by slip on the basal plane, but pyramidal as well as basal slip occurred in specimens containing grain boundaries. A.

539.4.019 : 537.533.9

3771. ANNEALING OF COLD-WORKED COPPER BY ELECTRON IRRADIATION. C.J.Meechan.
J. appl. Phys., Vol. 28, No. 2, 197-200 (Feb., 1957).

Copper wires were cold worked at room temperature to approximately a 15% reduction in area and were then irradiated at temperatures between 100° and 150°C with 1.25 MeV electrons. The residual resistivity was observed to decrease as a function of exposure at temperatures above 100°C. The higher the temperature at which the irradiation was performed, the greater was the rate of resistivity decrease. From these data, it is concluded that one of the primary defects produced by electron irradiation becomes mobile in the temperature range 100°-150°C. It is suggested that interstitials and vacancies produced by the irradiation initiate a process which results in the annihilation of dislocations. From an analysis of the temperature dependence of the rate of decrease, a value for the activation energy for vacancy migration in copper has been deduced: 1.28 ± 0.10 eV. A.

539.42 : 548.5

3772. TENSILE STRENGTH OF WHISKERS. S.S.Brenner.
J. appl. Phys., Vol. 27, No. 12, 1484-91 (Dec., 1956).

Tensile tests have been performed on whiskers of iron, copper, and silver 1.2 to 15μ in diameter. The strongest whiskers which were less than 4μ in diameter exhibited resolved elastic shear strengths of from 2 to 6% of their shear moduli. Stress—strain determinations on iron have shown that large deviations from Hooke's law occur beyond 2% strain. As the whiskers increase in size, their strengths decrease with considerable scatter. A.

539.42 : 548.5

MECHANICAL PROPERTIES OF SOLID ARGON. See Abstr. 2791

539.43 : 620.178

3773. AN AUTOMATIC ELECTROMECHANICAL STRESSING UNIT FOR CREEP AND FATIGUE TESTING. A.J.Kennedy and R.F.Slade.
J. sci. Instrum., Vol. 33, No. 11, 409-10 (Nov., 1956).

The apparatus is designed to apply a complex creep and fatigue stressing programme to a metal test-piece. A new electrical system has been developed which controls the extension of a mechanical spring in such a way that the test proceeds automatically under either constant stress or constant load, as required. The creep strain and the stress error are recorded during the test. The same system may be used to conduct creep recovery or stress relaxation tests. A.

539.43

3774. A NEW THEORY OF FATIGUE. A.A.Kheiralla.
Naturwissenschaften, Vol. 43, No. 14, 321-2 (1956).

It is assumed that the effect of each cycle of applied stress is to translate the stress state of each element of the material in an arbitrary direction in the space of principal stresses. Failure is taken to occur when the stress state reaches the critical surface, which is cylindrical if failure is independent of hydrostatic stress. The computation of failure is thus identical with the problem of random walk within a circle in stress space. An alternative approach is to view the problem somewhat similarly, but to treat the steps according to diffusion theory. Formulae are given for each of these cases.
A.J.Kennedy

539.431

3775. COMPRESSIONAL CREEP ON TIN SINGLE CRYSTALS. J.Weertman.
J. appl. Phys., Vol. 28, No. 2, 196-7 (Feb., 1957).

Compressional creep tests were run on single crystals oriented so that the direction of compression was along the c axis. Two activation energies of creep were found: approximately 24 500 cal/mole above 120°C and 12 000 cal/mole below this temperature. A.

539.576

3776. ON THE USE OF RADIOISOTOPES FOR THE DETERMINATION OF THE WEAR ON CUTTING TOOLS. S.Kaftal, R.Somigliana and S.Terrani.
Nuovo Cimento (Ser. 10), Vol. 4, No. 3, 637-41 (Sept., 1956). In Italian.

The radioactive tracer method for the measurement of wear on cutting tools is extended by dissolving the turnings in aqua regia, before making counts, in order to avoid corrections for the geometry of the source, self-absorption and backscattering. Absolute measurement of wear is made by comparing the activity of the solution from a fragment of the activated tool, with the activity of the solution from the turnings. Results obtained with drills of different mechanical characteristics working under the same conditions, are given. P.Rothwell

539.6

3777. THE INFLUENCE OF DUST PARTICLES ON THE CONTACT OF SOLIDS. J.B.P.Williamson, J.A.Greenwood and J.Harris.
Proc. Roy. Soc. A, Vol. 237, 560-73 (Nov. 20, 1956).

An investigation has been made of the manner in which two solids touch when one of the contacting surfaces is contaminated with dust. The behaviour is discussed in terms of the probability that intimate contact will be established between the solids in any particular closing operation. It is shown that this probability is related in a simple manner to the number and size of the contaminating particles, to the load between the solids, and to the nature of the contacting surfaces. The manner in which a dust particle can become trapped between the approaching bodies and thus prevent direct contact occurring is considered and a simple physical model of the processes is proposed. For this model, the dependence of the nature of the contact on the number and size of the contaminating particles is derived. The experimental behaviour is in good agreement with that predicted. The theoretical discussion indicates that the effectiveness of the contamination in preventing direct contact should fall off rapidly if the surface roughness is increased until the height of the irregularities is comparable with that of the particles. The effect has been verified experimentally. It has also been demonstrated that there is a sharp change in the probability of the occurrence of intimate contact if the area of contact between the solids is made comparable with the cross-sectional area of the particles. The practical significance of these observations is discussed. The various possible methods of increasing the probability that direct contact will occur are considered, and general relations are given by means of which the behaviour of two contacting solids under any given concentration of dust may be predicted. A.

539.62

3778. ROLE OF HYDRODYNAMIC LUBRICATION IN THE FRICTION OF FIBERS AND YARNS. W.W.Hansen and D.Tabor.
J. appl. Phys., Vol. 27, No. 12, 1558-9 (Dec., 1956).

Analysis of Lyne's data (Journal of the Textile Institute [Manchester], Vol. 46, 112, 1955) for friction of lubricated acetate yarn sliding over chromium pin shows explicit dependence of coefficient of friction on the product VZ/W (V = velocity, Z = viscosity, W = effective load), Results consistent with hydrodynamic lubrication. J.W.Menter

539.62 : 539.434

3779. THE VARIATION OF FRICTION WITH VELOCITY. R.T.Spurr and T.P.Newcomb.
Proc. Phys. Soc. B, Vol. 70, Pt 2, 198-200 (Feb., 1957).

It is shown that the friction of a bituminous material decreases with increasing sliding velocity, and that this decrease is due to the creep behaviour of the material. A.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM.

CHEMICAL REACTIONS 541.11/.12

541.123.2 : 537.562

3780. SYMMETRIC CHARACTER IN CERTAIN UNSYMMETRIC CHARGE TRANSFER REACTIONS. S.N.Ghosh and W.F.Sheridan.
J. chem. Phys., Vol. 25, No. 5, 1075 (Nov., 1956).

Charge transfer cross-sections for (A^+,CH_4), (A^+,C_2H_4), (A^+,C_2H_6) and also for the reverse reactions have been determined in the energy range 100 to 800 eV. The forward reactions have symmetric character i.e. the cross-section is large at low ion energies and falls to a steady value as the energy increases, probably because the neutralized ions or the newly created ions are excited to energy levels such that the energy defect of the reaction is zero. (CH_4^+,A), $C_2H_4^+,A)$ and $(C_2H_6^+,A)$ show a steady rise in cross-section with ion energy indicating that energy balance is not obtained in these reactions. G.Allen

541.123.21

3781. ON BRÖNSTED'S PRINCIPLE OF SPECIFIC INTERACTION. E.A.Guggenheim.
K. Danske Vidensk. Selsk., mat-fys. Medd., Vol. 30, Paper 14, 10 pp. (1955).

The single formulation by Guggenheim (Phil. Mag., Vol. 19, 588-643, March, 1935) of the theories of Brönsted, and of Debye and Hückel (J. phys. Chem., Vol. 58, 596, 1954) is re-examined mathematically and the criticisms of Scatchard answered. W.Good

541.123.5

3782. COMMENT ON THE SIGNIFICANCE OF DIFFUSION POTENTIALS IN ION EXCHANGE KINETICS. R.Schlögl and F.Helfferich.
J. chem. Phys., Vol. 26, No. 1, 5-7 (Jan., 1957).

The effect of the electric potential produced by diffusion in ion exchange kinetics is examined for the film-controlled exchange of monovalent ions. It is shown that, rather than resulting in a minor correction, the electric field as a rule makes an essential contribution to the process. A.

541.124 : 536.7

A RESTRICTIVE CONDITION FOR IRREVERSIBLE CHEMICAL TRANSFORMATIONS. See Abstr. 3219

541.127

3783. GAS-PHASE OXIDATION OF AMMONIA BY NITROGEN DIOXIDE. W.A.Rosser,Jr and H.Wise.
J. chem. Phys., Vol. 25, No. 5, 1078-9 (Nov., 1956).

The specific reaction rate is found to be $10^{12.7}e^{-27500/RT}$ cm^3 per mole-sec. The rate law found suggests a bimolecular reaction between NH_3 and NO_2 as the initial step, but the decrease in the rate constant with time and its dependence on surface imply complexity in the mechanism. W.Good

541.127

3784. PRECISION FLASH X-RAY DETERMINATION OF DENSITY RATIO IN GASEOUS DETONATIONS. R.E.Duff and H.T.Knight.
J. chem. Phys., Vol. 25, No. 6, 1301 (Dec., 1956).

Measurements of the density ratio (to within 1%) across a detonation wave in an equimolecular and lean acetylene-oxygen mixture, diluted with krypton, by an improved version of the X-ray densitometer developed by Kistiakowsky (Abstr. 2193/1952) show that for the equimolecular mixture the density ratio corresponds closely to that calculated by assuming all chemical reactions to be frozen along with vibrational degrees of freedom. The same is true of the lean mixture if it is assumed that steady state conditions were set up in the 16ft prior run of wave travel. R.C.Murray

541.127

3785. RELATIVE RATES OF SOME VERY RAPID GASEOUS BIMOLECULAR REACTIONS. J.Daen and R.A.Marcus.
J. chem. Phys., Vol. 26, No. 1, 162-8 (Jan., 1957).

Describes a steady-state flow apparatus which permits the measurement of relative rates of rapid gas phase bimolecular association reactions at very low pressures. Using this apparatus, the relative reactivities of the methylamines with boron trifluoride

were determined over the pressure range 0.009 to 0.04 mm Hg. Within the experimental error the ratio of rate constants, $k_{CH_3NH_2}/k_{(CH_3)_3N}$, was found to be pressure independent and to have a value of 1/12. A small number of experiments was made competing monomethylamine and dimethylamine for BF_3; for this system the ratio of rate constants, $k_{CH_3NH_2}/k_{(CH_3)_2NH}$ had an average value of 1/5. In addition to the above, experiments were made on various phenomena such as the sorption of BF_3 on various surfaces, the selectivity of a diffusion pump, and the extent of base exchange reactions, insofar as these factors pertained to the understanding of the relative rate measurements. A.

541.127

3786. THE RÔLE OF SPECIFIC DISSOCIATION PROBABILITIES IN THEORIES OF GAS REACTION RATES. N.B.Slater.
Proc. Leeds Phil. Lit. Soc., Vol. 6, Pt 5, 259-67 (Dec., 1955).

Slater's classical oscillator theory is consistent with the theories of Eyring and Kassel at high pressures, but differs from Kassel's theory at lower pressures. Kassel considered the specific dissociation probability (SDP), k_E, of molecules with a given total energy E whereas Slater considered the individual SDP, L, of molecules in states defined in greater detail. The role of the SDP is examined in an attempt to understand the discrepancy between the two theories. It is shown that if the high-pressure rate is of the form $Ae^{-B/T}$ for any classical theory based on harmonic vibrations, then the theory has a k_E identical with that of Kassel's theory. This is not generally true at lower pressures, when the probability of dissociation is not merely a function of the total energy of the molecule but can be specified in more detail in terms of its internal energy distribution. The decline in rate with pressure is governed by the ratio of the "effective molecular collision frequency" ω and the SDP, and it is argued that L rather than k_E should be used in the general rate equation. G.Allen

541.127

3787. ON THE THEORY OF UNIMOLECULAR GAS REACTIONS: THE EFFECT OF ANHARMONICITY ON HIGH-PRESSURE RATES. N.B.Slater.
Proc. Leeds Phil. Lit. Soc., Vol. 6, Pt 5, 268-74 (Dec., 1955).

In the theory of unimolecular gas reactions the molecule is usually treated as a harmonically vibrating system and it is assumed that the vibrations are harmonic up to the point of rupture. Slater's classical model is modified by including anharmonic terms in the potential energy in the form of cubic terms involving the dissociation coordinate. The effect on the high-pressure rate is small for typically large activation energies ($E_0/kT = 40$). The critical extension q_0 is $\sqrt{3}$ times as great in the anharmonic case as in the harmonic case. The agreement between the results of Slater's classical-oscillator theory and those of Eyring's activated complex theory is also discussed; it is due in part to a harmonic approximation common to both theories. G.Allen

541.128 : 548.736.4

3788. CATALYTIC EFFECTS OF TiO_2 AND MnO_2 ON THE PHASE TRANSFORMATION OF GOTHITE. S.C.Chakraborty and A.Roy.
J. chem. Phys., Vol. 25, No. 5, 1079-80 (Nov., 1956).

X-ray diffraction experiments reveal that the gradual addition of MnO_2 and TiO_2 causes a lowering of the transition temperature of gothite from 250°C to 190°C and to 210°C respectively. It is suggested that these different lowerings may be due to different particle sizes of the impurities. W.Good

541.128.13

3789. DISLOCATIONS AS "ACTIVE SITES" IN HETEROGENEOUS CATALYSIS. L.E.Cratty, Jr and A.V.Granato.
J. chem. Phys., Vol. 26, No. 1, 96-7 (Jan., 1957).

Experiments on the dependence of catalytic activity of nickel foils as a function of deformation and annealing are interpreted as evidence that dislocations are active sites in heterogeneous catalysis. A.

ELECTROCHEMISTRY 541.13

541.13 : 536.7

ELECTROCHEMICAL CELL POTENTIALS. THERMODYNAMIC THEORY. See Abstr. 3218

541.133

3790. CONCENTRATION DEPENDENCE OF THE ELECTRICAL CONDUCTIVITY OF BINARY SALT MELTS. B.F.Markov and L.A.Shumina.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 3, 411-13 (1956). In Russian.

It is shown from measurements on KCl–NaCl, $PbBr_2$–$PbCl_2$, KCl–LiCl and KNO_3–$NaNO_3$ that the electrical conductivity of binary fused salt systems forming solid solutions can be described by the equation $\lambda_m = x_1^2\lambda_1 + x_2^2\lambda_2 + 2x_1x_2\lambda_1$, where the λ's are equivalent conductivities, and the x's are mole fractions. However it would be erroneous to suppose that this equation can correctly describe the electrical conductivity variation in the eutectic melts. The departure of the electrical conductivity of these melts from that predicted by this equation can be regarded as a characteristic of their departure from ideality. R.C.Murray

PHOTOCHEMISTRY.

RADIATION CHEMISTRY 541.14/.15

541.14 : 535.333

3791. THE FLASH PHOTOLYSIS OF DIACETYLENE.
J.H.Callomon and D.A.Ramsay.
Canad. J. Phys., Vol. 35, No. 2, 129-33 (Feb., 1957).

A brief description is given of a "microsecond" flash photolysis apparatus in which a 40 μf condenser charged to 8000 V is discharged through a photolysis flash tube in ~ 20 μsec. Absorption spectra of transient species are photographed with a second flash tube which provides a source of continuum by discharging a 2 μf condenser charged to 10 000 V, in 3-5 μsec. A circuit for controlling the time interval between the two flashes is given. Experiments on the flash photolysis of diacetylene are discussed. With diacetylene at 0.5 mm Hg pressure several well-known band systems were photographed in absorption 20 μsec after the beginning of the photolysis flash, viz., the C_2 Swan bands, the C_2 Phillips bands, the C_2 Deslandres-d'Azambuja bands, the 4050 Å bands of C_3, and the CH band at 3143 Å. The rotational temperature of these bands was ~ 3000°-5000°K. The C_2 Swan bands were also recorded in emission after a single photolysis flash. When a considerable excess (100 : 1) of helium was added to the diacetylene, all the above band systems disappeared with the exception of the C_3 bands. In the absence of helium it is probable that the reaction is mainly thermal and that the high temperature is produced by a thermal explosion of the diacetylene triggered by the photolysis flash. The thermal reaction is suppressed by the addition of excess helium and the photochemical reaction becomes dominant. Under these conditions it is interesting to note that C_3, but no C_2, is produced. It appears therefore that C_3 is a product of the photochemical decomposition of diacetylene. Possible mechanisms are discussed. A.

541.14

3792. MATRIX ISOLATION STUDIES: INFRARED SPECTRA OF INTERMEDIATE SPECIES IN THE PHOTOLYSIS OF HYDRAZOIC ACID. E.D.Becker, G.C.Pimentel and M.Van Thiel.
J. chem. Phys., Vol. 26, No. 1, 145-50 (Jan., 1957).

The matrix isolation method has been used to investigate the photolysis of hydrazoic acid (HN_3) suspended in xenon, argon and nitrogen matrices at 20°K. Infrared spectra of the photolyzed material in argon and nitrogen matrices show absorption bands of NH_3 and a number of other prominent spectral features that are probably due to unstable molecules, including intermediates in the formation of NH_3. In a xenon matrix no new bands are observed on photolysis of HN_3 at 20°K, but the presence of the imine radical (NH), or of nitrogen and hydrogen atoms, is inferred from the formation of NH_4N_3 when the material is warmed to 70°K. The mechanism of photolytic production of radicals in a matrix is examined, and the probable importance of the heat of fusion of the matrix is discussed. The utility of the matrix isolation technique in the infrared study of unstable reaction intermediates is demonstrated. A.

541.15

3793. INDIRECT ACTION OF RADIATION ON THE –NH–CH_2– LINKAGE IN DIETHYLAMINE (A MECHANISM FOR RADIATION-INDUCED DECOMPOSITION OF THE PEPTIDE CHAIN).
M.E.Jayko and W.M.Garrison.
J. chem. Phys., Vol. 25, No. 5, 1084 (Nov., 1956).

Recent studies show that the radiation-induced decomposition at the N-C bond of aqueous glycine proceeds by the intermediate formation of imine to give ammonia and glyoxylic acid (Garrison and Weeks, Abstr. 5479/1956, 1710/1957). These studies have been extended to show that secondary amines behave similarly, yielding aldehydes and primary amines by the indirect action of radiation.

Experiments are described in which oxygen-aerated 0.1 M diethylamine solutions at pH 3 were irradiated by 12 MeV electrons produced by a 60 in. cyclotron at a beam current of 0.01 μA. Experimental techniques are indicated briefly. The initial G values for ethylamine and acetaldehyde were ~0.8 and ~0.5 respectively. The authors suggest that these results may be applied to the radiation-induced cleavage of the peptide chain and give a possible scheme of reaction. C.E.King

541.15

3794. RECOIL ENERGY EFFECTS IN THE HOT ATOM CHEMISTRY OF IODINE. R.H.Schuler and C.E.McCauley.
J. chem. Phys., Vol. 25, No. 5, 1080-1 (Nov., 1956).

Experiments are described which show that, for cyclohexane solutions of iodine, the retention of activity by the organic fraction is greater for the (n,2n) isotope I^{126} than for the (n,γ) isotope I^{128}. The irradiation was performed using the fast neutrons produced by a beryllium target bombarded by 20 MeV deuterons in a 60 in. cyclotron. Experimental methods for the measurement of activity are indicated, and agreement with some previous values is obtained. It is suggested that the difference in retention of activity for the two isotopes in cyclohexane solution may be correlated with the greater recoil energy of the (n,2n) isotope. The latter, in dissipating its energy by collision, will produce a larger number of organic fragments able to react with the active atom to give organic activity. The similarity of retention values for the alkyl iodide is correlated with the rapid dissipation of recoil energy by collision with the heavy iodine atoms of the substrate and by the production due to these collisions of free iodine atoms able to combine with the active iodine to give inorganic active molecules. C.E.King

541.15

3795. CHEMICAL ACTION OF ULTRASONIC RADIATION ON WATER AND AQUEOUS SOLUTIONS. M.Haïssinsky and A.Mangeot.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1086-95 (Nov., 1956). In French.

The formation of H_2O_2 and the oxidation of various aqueous solutions has been studied in atmospheres of oxygen and of argon. The quantity U, defined as the ratio between the number of molecules formed in unit time and in unit volume to the number of molecules of H_2O_2 formed in pure water in an atmosphere of oxygen, under standard conditions of temperature, frequency and pressure, is introduced to express the ultrasonic transformations in order of magnitude and to compare the yields under different conditions. The presence of oxygen is not indispensable to ultrasonic oxidation, nor to the formation of H_2O_2, which is notably influenced by the presence of neutral electrolytes, and which is inhibited by HCl and HNO_3. H_3PO_3, which is hardly oxidized at all by H_2O_2, is completely oxidized by the ultrasonic method. A comparison is made between the chemical effects of the ultrasonic radiation and those of α-rays. A.J.Mee

DISPERSIONS. COLLOIDS. ADSORPTION

541.18

541.182.2

3796. CONTRIBUTION TO THE STUDY OF ELECTROLYSIS BY SPARK. THE CATHODIC ATOMIZATION OF ELECTROLYTES. P.Barret.
Bull. Soc. Chim. France, 1956, No. 8-9, 1243-53 (July-Aug.). In French.

An account of a phenomenon observed in the course of an investigation into the production of aerosols using electrical discharges. The phenomenon is the formation of droplets on a platinum wire cathode suspended over the surface of ionized liquids and the atomization of these to form aerosols. A brief description of the apparatus and results obtained is given. A detailed discussion interprets the results and gives a theory of the mechanism of the phenomenon. W.A.Walker

541.182.5 : 534.321.9

3797. ORIENTATION PRODUCED BY SOUND VIBRATION IN SILICA GEL. L.Holzapfel and K.Schriever.
Naturwissenschaften, Vol. 43, No. 14, 322 (1956). In German.

X-ray diagrams show increasing sharpness of diffraction lines from gels subject to increasing periods of sound vibration. W.Good

541.183.2

3798. RELATION BETWEEN ADSORPTION ISOTHERM AND ADSORPTION RATE EQUATION. T.Keii.
J. chem. Phys., Vol. 25, No. 6, 1283-4 (Dec., 1956).

Using the theory of Roginskii (Advances in Catalysis, Vol. 5, 217, 1953) and the rule of Horiuti and Polanyi (Acta Physicochimica URSS, Vol. 2, 505, 1935) it is shown that if an equation of adsorption rate is found at a given temperature and pressure, the form of the adsorption isotherm can be inferred for the same conditions, and vice versa. S.J.Gregg

541.183.2 : 545.844

3799. STOCHASTIC CONSIDERATIONS ON CHROMATOGRAPHIC DISPERSION. J.C.Giddings.
J. chem. Phys., Vol. 26, No. 1, 169-73 (Jan., 1957).

The band-structure problem of chromatography is approached using concepts from discrete probability theory and passing to the limit for the continuous case. Both the one-site and two-site problems are treated under the stipulation of linear adsorption properties. A two-site expression has been derived which is complicated only by the need to evaluate one integral numerically. The band structure is given for two hypothetical cases, one involving one-site and the other the more complicated two-site processes. A.

CHEMICAL STRUCTURE 541.2/.6

541.451

3800. THE ORIGIN OF THE HYDRATED OXIDE FORMED WHEN ANODIC ALUMINIUM OXIDE FILMS ARE "SEALED" IN BOILING WATER. I.S.Kerr.
Proc. Phys., Soc. B, Vol. 69, Pt 10, 1055-6 (Oct., 1956).

Areas of aluminium oxide film from which the aluminium substrate had been largely, but not completely, removed were "sealed" and then examined by electron microscopy and electron diffraction. It appeared that boehmite was only formed in the immediate vicinity of residual flakes of aluminium metal. K.W.Plessner

541.6

3801. BOILING POINT AND OTHER PHYSICAL PROPERTIES OF THE HALOGENS AND HALIDES. G.R.Somayajulu.
Indian J. Phys., Vol. 30, No. 5, 258-61 (May, 1956).

The properties (P) of boiling point, atomic volume, refractivity, atomic co-valent radius squared, Van der Waals' radius cubed, and polarizability are given by the relation $P = a\Sigma(Z - S) + b$, where a and b are constants for any particular series of molecules, Z is the atomic number and S is a constant, characteristic for each halogen. W.Good

541.6

3802. BOILING POINT AND ATOMIC SIZE. G.R.Somayajulu and S.R.Palit.
Indian J. Phys., Vol. 30, No. 5, 262-4 (May, 1956).

See preceding abstract. Further data lead to the conclusion that the boiling points of the halogens and similar halogen compounds are linearly proportional to the sum total of the surface area of the halogens in the molecule. W.Good

541.6

3803. RELATIVE BASICITY OF ALKYL BENZENES. D.Cook.
J. chem. Phys., Vol. 25, No. 4, 788-9 (Oct., 1956).

The order of relative basicity of the alkyl benzenes is determined from the shift in the infrared fundamental νHCl in HCl-alkyl benzene complexes. The order of basicity for the mono-substituted benzenes is Me > Et ~ iPr < tBu (~Me). Hexa-ethyl benzene is intermediate in basicity between pentamethyl benzene and 1,2,4,5-tetramethyl benzene. G.Allen

541.64

3804. FORMATION OF HIGH POLYMERS THROUGH METAL REINFORCEMENT OF POLYMERIC OIL-CONTAINING FILM-FORMERS AND OF VARIOUS SYNTHETIC RESINS. F.Schlenker.
Kunststoffe, Vol. 47, No. 1, 7-14 (Jan., 1957).

A review. Metal reinforcement means the conversion of low-molecular compounds with reactive groups into macromolecules through "metal active" compounds, which are organometallic compounds whose polyvalent metal atoms can react with the reactive groups of the low-molecular compounds. They represent a bridge between purely organic polymers and those of predominatly inorganic character. R.C.Murray

541.64 : 536.422.15

VAPOUR PRESSURE OF PLASTIC MATERIALS.
See Abstr. 3198

541.67

3805. METHODS OF PREPARATION AND CRYSTAL CHEMISTRY OF FERRITES. D.L.Fresh.
Proc. Inst. Radio Engrs, Vol. 44, No. 10, 1303-11 (Oct., 1956).

Conventional ceramic methods for pure oxide materials can generally be applied to the processing of ferrites. Specialized techniques such as coprecipitation and hydrostatic pressing are sometimes employed. A process involving nonaqueous milling and forming additives provides dense shapes. The general formula for ferrites is $MO \cdot Fe_2O_3$ (M is a divalent metallic cation). X-ray diffraction may be used to conduct unit cell and phase relation studies. Metallurgical micrographic techniques are useful in investigating grain and pore structure. A study of the solid-state reaction kinetics of an equimolar mixture of MgO and Fe_2O_3 at elevated temperatures showed that the reaction was expressed by the diffusion equation $[1 - \sqrt[3]{(1 - 0.01x)}]^2 = K$ where x is the percentage of reaction at time t, and K is a constant. A.

CHEMICAL ANALYSIS 543/545

543.7

3806. INEXPENSIVE WAY TO CONTROL OXYGEN IN SODIUM HEAT-TRANSFER SYSTEMS. I.L.Gray, R.L.Neal and B.G.Voorhees.
Nucleonics, Vol. 14, No. 10, 34-7 (Oct., 1956).

The amount of oxide in molten Na and Na–K systems was measured by bypassing a fraction of the flow through a section containing a cooled perforated plate. The temperature at which the plate became blocked by oxide deposition determined the oxygen content: the precision attained over the range 0.0006-0.024 wt % O_2 was better than ± 0.001 wt % O_2. The design and performance of stainless steel wool packed cold-traps for oxide removal are described. R.D.Smith

545.84

3807. AN AUTOMATIC ANALYSER OF URANIUM CONTENT IN PROCESS STREAMS. H.Bisby, L.H.Brown and D.R.Chapman.
J. sci. Instrum., Vol. 33, No. 12, 467-75 (Dec., 1956).

The instruments described employ an absorptiometric technique for the determination of uranium-ion concentrations in aqueous solutions. Contemporary batch samples are taken in cyclic order from process streams, separately treated with aqueous ammonium thiocyanate, and the resulting colour complexes are analysed by an ultraviolet absorptiometer at 3650 A. The cycle of events is entirely automatic and a permanent record of the uranium-ion concentration of the individual streams is produced. A four-point general-purpose analyser and a sixteen-point analyser for low (0.005 g/l.) concentrations of uranium are described in detail. The instrumental techniques evolved have wider applications in automatic chemical analysis. A.

CRYSTALLOGRAPHY 548

548.232.2

3808. SPIRAL CLEAVAGE OF MICA. K.Kinosita and J.Nakayama.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1055-8 (Oct., 1956).

The authors came across a slice of mica which was cleaved spirally, the spiral lamella being several hundredths mm thick. Detailed observations on the structure of this specimen including polarization microscopic and X-ray studies are described. A tentative explanation of the origin of this unusually thick growth-layer is proposed assuming that an external force, which was exerted during the formation of the crystal, caused the left and right halves of the crystal to make a small relative rotation around the a-axis. A.

548.4

3809. VOLATILE IMPURITIES IN SILICON AND GERMANIUM. H.A.Papazian and S.P.Wolsky.
J. appl. Phys., Vol. 27, No. 12, 1561 (Dec., 1956).

A mass spectrographic analysis has demonstrated the presence of H, O, and C in Ge and Si, and of N in Ge only, but the precise form in which the impurities exist in the crystals is not known. C.A.Hogarth

548.5

3810. GROWTH BENDS IN IRON WHISKERS. G.S.Baker.
J. appl. Phys., Vol. 27, No. 12, 1561-2 (Dec., 1956).

Back reflection Laue X-ray patterns of Fe whiskers with sharp bends, grown from the vapour, showed that the orientation of the crystal lattice remains unchanged at a bend. The lattice of a whisker bent in a smooth arc is uniformly rotated along the arc. J.Franks

548.52

3811. GROWTH FEATURES OF COLLOIDAL LEAD HYDROXIDE CRYSTALS. R.Takagi.
Naturwissenschaften, Vol. 43, No. 14, 322-3 (1956).

The crystals were prepared by ageing black aqueous suspensions of colloidal lead in hexagonal, irregular or dendritic form. Laminar growth and edge growth was observed. Electron diffraction patterns show a difference between the hexagonal and the dendritic form. The latter show a trigonal characteristic in the branching formation. W.Bardsley

548.523

3812. ON THE THEORY OF ELECTROLYTIC CRYSTAL GROWTH. D.A.Vermilyea.
J. chem. Phys., Vol. 25, No. 6, 1254-63 (Dec., 1956).

Equations are developed for the current as a function of applied voltage during electrolytic solution or deposition at surfaces which are perfect, atomically rough or smooth except for the steps of screw dislocations. It is shown that the surface structure does not influence the rate of deposition if the overvoltage is sufficiently high and the time long enough, the rate-determining step being ionic discharge. At low overvoltages and short times, however, the surface structure plays a decisive role in determining the deposition rate. Changes in the surface configuration during growth, such as the change from a straight to a spiral dislocation step, lead to transient effects at the start of deposition or solution. A.

548.55

3813. THE INFLUENCE OF IMPURITIES ON THE MACRO-MOSAIC STRUCTURES OF TIN AND LEAD. H.A.Atwater and B.Chalmers.
Canad. J. Phys., Vol. 35, No. 2, 208-15 (Feb., 1957).

The properties and characteristics of arrays of low-angle boundaries which appear upon freezing of single crystals of tin and lead from the melt are shown to be dependent upon the amount and kind of impurities in the freezing liquid. The boundary-direction angle as a function of lattice orientation and impurity content in crystals frozen at speeds greater than 18-20 mm/minute is employed as an observational quantity. Measurements of boundary-direction are given for various impurity concentrations and types. Mechanisms for the determining of the boundary directions are proposed. A.

548.57

3814. STRUCTURE OF BENT ZINC CRYSTALS. C.T.Wei and P.A.Beck.
J. appl. Phys., Vol. 27, No. 12, 1508-18 (Dec., 1956).

Zinc crystals were bent either by wrapping them around a mandrel or by the application of a concentrated load in a direction perpendicular to the basal plane. The structure of the bent crystals was studied by means of suitable X-ray diffraction techniques, namely the Lambot technique and the Schulz technique. It was found that, after bending around a mandrel of sufficiently small radius, the zinc crystals were subdivided into subgrains, with an average disorientation between neighbouring subgrains of approximately 3 minutes of arc. In the dimples formed by a concentrated load the radius of bending is quite large and there is hardly any observable substructure. However, the substructure does develop upon annealing by the polygonization mechanism. The diameter of the dimples

formed by a concentrated load increases linearly with the logarithm of the time of load application for a constant load, and it increases linearly with the load if the time of load application is constant.

A.

548.57

3815. GROWTH OF LARGE DIAMETER SILICON AND GERMANIUM SINGLE CRYSTALS. W.R.Runyan.
J. appl. Phys., Vol. 27, No. 12, 1562 (Dec., 1956).

Crystals of Ge (6 in. dia., wt. 4 lb.) and Si (4 in. dia., wt. 1lb) were grown by the Teal–Little method in a 20 kW r.f. furnace in a He atmosphere, with temperature control to a few tenths of a degree. All crystals were grown in the [111] direction at pull rates of 0.1-0.6 mils/sec. Seeds 0.3 in. square provided adequate heat transfer and support for both Ge and Si crystals. J.Franks

548.57

3816. PERIODICITY IN ICE - FLOWERS. F.C.Frank and A.Keller.
Phil. Mag. (Eighth Ser.), Vol. 1, 975-6 (Oct., 1956).

The periodicity is illustrated by photographs, and may be due to rhythmic crystallization, analogous to the Liesegang phenomenon, or to slow twist about the hexagonal axis during crystal growth.

R.F.S.Hearmon

548.574

3817. DISLOCATION ETCH PITS IN SILICON CRYSTALS. F.L.Vogel,Jr and L.C.Lovell.
J. appl. Phys., Vol. 27, No. 12, 1413–15 (Dec., 1956).

A method for suitably etching dislocations in silicon crystals is reported. Using this etch, dislocations in various arrays were observed: low angle boundaries, slip lines, polygonization walls, and bent crystal distributions. A

ATOMIC AND X-RAY CRYSTALLOGRAPHY

548.7

548.7

3818. RADII OF TRANSITION IONS IN CRYSTAL FIELDS. N.S.Hush and M.H.L.Pryce.
J. chem. Phys., Vol. 26, No. 1, 143-4 (Jan., 1957).

The radii of divalent and trivalent iron-group ions, unlike those of ions with spherically symmetrical ground states, do not vary regularly with atomic number. This is interpreted as an environmental effect, resulting from crystal field splitting of the lower energy levels. An approximate calculation of the crystal-field radius contraction has been made for the hexaquo complexes present in crystalline hydrates and in aqueous solutions of the divalent ions. When this is subtracted from the observed radii, the resulting "corrected" quantities exhibit the smooth variation with atomic number expected for free ions. A.

548.7

3819. CALCULATION OF THE BAND STRUCTURE OF "COMPLEX" CRYSTALS. B.Segall.
Phys. Rev., Vol. 105, No. 1, 108–15 (Jan. 1, 1957).

A method for studying the band structure of "complex" crystals (i.e., crystals having more than one atom per unit cell) is developed. This method is a generalization of one proposed independently and arrived at by different approaches by Koringa, Kohn and Rostoker for the study of the band structure of "simple" crystals. The general approach leads to a promising method when the crystalline potential can reasonably be approximated by a potential which is spherically symmetric within nonoverlapping spheres about the lattice sites and is constant elsewhere. Important virtues of the method are its expected accuracy and the fact that the largest part of the labour involved is in the computation of certain "structure constants" which are applicable to all crystals with the same crystallographic structure.

A.

548.7

3820. NONRADIATIVE TRANSITIONS OF TRAPPED ELECTRONS IN POLAR CRYSTALS. J.J.O'Dwyer and P.G.Harper.
Phys. Rev., Vol. 105, No. 2, 399-400 (Jan. 15, 1957).

An algebraic formula is derived which represents the integral expression of Huang–Rhys for nonradiative transitions of trapped electrons in polar crystals. The formula is a good representation over a very wide range of trap depths and coupling constants. A.

548.7

3821. POSITION OF THE α AND β BANDS IN ALKALI-HALIDE CRYSTALS. F.Bassani and N.Inchauspé.
Phys. Rev., Vol. 105, No. 3, 819-22 (Feb. 1, 1957).

The traditional model of the exciton is used to determine the positions of the α band and the β band relative to the first maximum of the fundamental absorption bands. The β band is considered to be due to an exciton created in the immediate vicinity of an F centre and the α band to an exciton created in the immediate vicinity of a negative-ion vacancy. Simple assumptions are made in performing the calculations of the energy required to create the exciton. The results obtained agree satisfactorily with the available experiments.

A.

548.7

3822. A MANY-ELECTRON TREATMENT OF THE MOTION OF AN ELECTRON (HOLE) IN A DEFORMED CRYSTAL. T.I.Kucher and K.B.Tolpygo.
Zh. éksper. teor. Fiz., Vol. 31, No. 6(12), 1002-11 (1956). In Russian.

The many-electron treatment of the motion of an electron (or a hole) in an ionic crystal is extended to the case of nuclei which are not fixed and vacancy of any ion. The theory is developed in the strong-coupling approximation on the basis of antisymmetrized wave-functions and can be applied to short-range states. A method for calculation of the crystal deformation and energy of the local self-consistent state is given. A.

548.7

3823. THE QUADRUPOLAR EFFECT IN ALKALI HALIDE MIXED CRYSTALS. H.Kawamura, E.Otsuka and K.Ishiwatari.
J. Phys. Soc. Japan, Vol. 11, No. 10, 1064-92 (Oct., 1956).

Using NaBr–NaCl mixed crystals, the quadrupole effect on the nuclear resonance absorption line of Na has been observed. The minority halogen plays the role of "impurity" or "solute" as in the case of alloys treated by Bloembergen and Rowland. The satellites of Na in NaCl are affected when the solute Br comes at the third halogen site counted from Na site, where the field gradient then becomes $q \cong 10^{21}\ cm^{-3}$. From analysis, the antishielding factor λ for Na is given as ~ 10. The asymmetric broadening of the central line due to the second order perturbation occurs when and only when the solute comes next to the Na nucleus. The specimen being a single crystal, the satellites of the second order arise at the definite positions depending upon the direction and strength of the external magnetic field. By measuring this shift of the resonance field, it is seen that the field gradients produced at the Na site are nearly $1.4 \times 10^{23}\ cm^{-3}$ and $2.0 \times 10^{23}\ cm^{-3}$, when Br^- and Cl^- are the solute ion, respectively. On account of the segregation of the solute ions within the crystal, each Na site has only a rare chance of having more than one solute ion next to it. A.

548.7

3824. QUADRUPOLAR NUCLEAR SPIN–LATTICE RELAXATION IN CRYSTALS WITH BODY-CENTERED CUBIC LATTICE STRUCTURE. T.P.Das, D.K.Roy and S.K.Ghosh Roy.
Phys., Rev., Vol. 104, No. 6, 1568-72 (Dec. 15, 1956).

Van Kranendonk has estimated the effect of lattice vibrations in contributing to the spin–lattice relaxation time due to quadrupole interaction in crystals with a simple cubic structure (Abstr. 2300/1955). His method is extended to the case of crystals with a body-centred cubic structure. A.

548.7

3825. SODIUM NUCLEAR QUADRUPOLE INTERACTIONS IN $NaClO_3$ AND $NaBrO_3$. H.S.Gutowsky and G.A.Williams.
Phys. Rev., Vol. 105, No. 2, 464-8 (Jan. 15, 1957).

The electric quadrupole splitting of the Na^{23} nuclear magnetic resonance has been measured in single crystals as a function of pressure and of temperature for $NaClO_3$ and as a function of pressure for $NaBrO_3$. The values for $(1/P)\Delta\nu/\nu$ are $+7.7 \times 10^{-6}$ and $+6.0 \times 10^{-6}\ kg^{-1}\ cm^2$, respectively, and for $(1/T)\Delta\nu/\nu$, $-4.2 \times 10^{-4}\ deg^{-1}$. The results suggest that the temperature and pressure dependence of the sodium coupling results mainly from the change with volume of the crystalline field, which also makes an appreciable contribution to the temperature dependence of the chlorine coupling. e^2qQ/h for sodium is found to be 779.2 ± 4 kc/s in $NaClO_3$ and 842.4 ± 4 kc/s in $NaBrO_3$. In $NaClO_3$ the electric field gradient at the sodium nuclei varies with volume approximately as V^{-2} indicating the importance of other than simple Coulombic effects. A.

548.7

3826. SIGN OF THE CRYSTALLINE CUBIC FIELD SPLITTING PARAMETER a IN AN S STATE. W.Low.
Phys. Rev., Vol. 105, No. 3, 792-3 (Feb. 1, 1957).

Measurements of the paramagnetic resonance spectrum of manganese and ferric ions at low temperatures yield the values for the cubic field splitting parameter a as 18.6×10^{-4} and 205×10^{-4} cm^{-1} respectively. The sign of a is positive in both cases, indicating that the twofold degenerate level is lower than the fourfold degenerate level. This is in contrast with Bleaney and Trenam's results on ferric alums who find a negative a. For gadolinium in CaF_2, the constant $a=175\times10^{-4}$ cm^{-1} and is also positive. A.

548.7

3827. PARAMAGNETIC RESONANCE SPECTRUM OF MANGANESE IN CUBIC MgO AND CaF_2. W.Low.
Phys. Rev., Vol. 105, No. 3, 793-800 (Feb. 1, 1957).

The paramagnetic resonance spectrum of manganese in cubic MgO and CaF_2 has been analysed at wavelengths of 1 and 3 cm. The cubic field splitting in MgO is given by $3a = (+55.9 \pm 0.9) \times 10^{-4}$ cm^{-1}. The twofold degenerate level lies lower than the fourfold degenerate level. The hyperfine structure constant is $A = (-81.0 \pm 0.2)\times10^{-4}$ cm^{-1}; $g = 2.0014 \pm 0.0005$. The large cubic field splitting and the reduced hyperfine structure point towards considerable covalent bonding. Anomalous intensity ratios of the fine structure lines were observed. In CaF_2 the hyperfine structure constant has a value of $A = (95 \pm 1) \times 10^{-4}$ cm^{-1}. The line width of 40 gauss even at very low concentration prevented any resolution of fine structure. The large line width is probably caused by the interaction of the magnetic electrons with the fluorine ions. A.

548.7

3828. $\alpha \rightarrow \beta$ TRANSFORMATION OF QUARTZ. S.M.Silverman.
J. chem. Phys., Vol. 25, No. 5, 1082 (Nov., 1956).

Considering the transformation as a special case of formation of lattice imperfections the energy barrier to the formation of the latter is evaluated using specific heat data. The result is found to be 32.2 kcal per mole transformed from the completely ordered to the completely disordered states. W.Good

548.7

3829. ADDITIONAL ABSORPTION OF MIXED CRYSTALS OF SILVER HALIDES WITH IMPURITIES. H.Sauvenier.
Mem. Soc. Roy. Sci. Liège, Vol. 16, No. 2, 1-63 (1955). In French.

The results obtained by Stasiw (Abstr. 6114, 7593/1950) are interpreted and some alternative explanations for the additional absorption due to the impurity are given. J.E.Caffyn

548.7

3830. THE BLACKENING OF ZINCBLENDE CRYSTALS IN RELATION TO THEIR ABSORPTION BANDS. W.Bontinck and W.Dekeyser.
Naturwissenschaften, Vol. 43, No. 14, 323-4 (1956).

A preliminary report on changes in optical absorption of natural transparent ZnS crystals brought about by heating them in H_2, Zn and S atmospheres and in vacuum. All four treatments led to the formation of colloids within the crystals; the associated absorption bands lie between 4500 and 7000 A and are responsible for the observed blackening. In addition it was observed that heating in either a Zn or a S atmosphere increased the heights of those absorption bands at 3600 and 4000 A present in the untreated crystals, although in a hydrogen atmosphere these bands are decreased. It is suggested that the colloids are specks of Zn metal and also that the 3600 and 4000 A bands are associated with atomic defects, possibly interstitial Zn ions. A.B.Lidiard

548.7 : 535.343

REFLECTION SPECTRUM AND STRUCTURE IN THE EXCITON ABSORPTION PEAK OF NaCl AND KCl. See Abstr. 3138

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.732

3831. THE INTERPRETATION OF DIFFUSE THERMAL-WAVE SCATTERING OUTSIDE THE RECIPROCAL REGION COVERED BY CRYSTAL REFLECTIONS. W.Hoppe.
Acta cryst., Vol. 9, Pt 9, 770-1 (Sept., 1956). In German.

The theory of Herbstein and Schmidt (Acta cryst., Vol. 8, 406, 1955) for α-phenazin, that this diffuse scattering is due to thermal broadening of Bragg reflections, is considered to be unsatisfactory. The general theory of thermal diffuse scattering, as applied to a structure containing a rigid molecular group, is discussed. A.R.Stokes

548.732

3832. REFLECTION PROPERTIES OF THE 211 PLANES IN CALCITE. C.Nordling.
Ark. Fys., Vol. 11, Paper 3, 79-85 (1956).

Measurements of the percentage reflection, the double-crystal coefficient of reflection and the width of the rocking curve were made in the wavelength range 558 X.U. to 5750 X.U. These are compared with theoretical calculations. J.Adam

548.735

3833. THE SEPARATION OF THE INTERFERENCE FUNCTION AND THE STRUCTURE FUNCTION FROM THE X-RAY DIFFRACTION PICTURE. L.Hyvärinen and P.Rautala.
Ann. Acad. Sci. Fennicae AI, Paper 211, 14 pp. (1955).

The intensity function I is a product of the structure function $|F|^2$, which reflects the electron density distribution within a unit cell, and the interference function I_0 which reflects the size of diffracting blocks. All three functions are continuous. The paper shows how the square of convolution of the electron density function can be obtained from intensity curves. The result is independent of the size distribution of the mosaic blocks, provided the individual blocks are small. The problem is treated in one dimension. J.Adam

548.735

3834. CRYSTALLITE SIZE DETERMINATION FROM X-RAY INTERFERENCE FUNCTION. L.Hyvärinen and P.Rautala.
Ann. Acad. Sci. Fennicae AI, Paper 212, 13 pp. (1955).

It was shown earlier (see preceding abstract) that there exists a direct method of separating the interference function from the intensity function. Two methods are given in this paper to calculate the size distribution function from the interference function. J.Adam

548.735

3835. A NEW METHOD FOR THE STRUCTURE ANALYSIS OF NON-CENTROSYMMETRIC CRYSTALS. G.N.Ramachandran and S.Raman.
Curr. Sci., Vol. 25, No. 11, 348-51 (Nov., 1956).

See Abstr. 1754 (1957). The use of anomalously scattering atoms for phase determination was tested on ephedrine hydrochloride, and, in general, the agreement between measured and calculated phase angles was good. It is suggested that with a pair of isomorphous compounds, in which the replaceable atoms are both anomalous scatterers, phase angles could be obtained unambiguously. A.R.Stokes

548.735

3836. THE FUNDAMENTALS OF DIFFRACTION MICROSCOPY. R.Hosemann and R.Bonart.
Z. Phys., Vol. 146, No. 3, 350-71 (1956). In German.

A development of theories put forward earlier regarding the use of "Q" functions in the interpretation of diffraction patterns. The application to the contradiction between the conventional theory of fluids and the theory of "ideal" para-crystals is discussed (see Hosemann and Bagchi, Abstr. 9161/1952, 7310, 8076/1953, 1007/1954). J.Iball

548.735.4 : 518.5

3837. A VARIABLE STRUCTURE-FACTOR GRAPH FOR USE IN CRYSTAL-STRUCTURE DETERMINATION. K.A.Morley and C.A.Taylor.
J. sci. Instrum., Vol. 34, No. 2, 54-8 (Feb., 1957).

The instrument incorporates two tables, linked so that a rotation of one causes an identical rotation of the other. A drawing of proposed atomic positions is placed on one table and lies under a net of parallel wires which represent the contours of a structure-factor graph. The spacings of these wires and the relative orientation of the drawing may be adjusted to correspond with any given point on a representation of the diffraction pattern placed on the second table. Suggestions may then be obtained, from the relative disposition of atomic positions and contour lines, for changes that would improve the agreement between the diffraction patterns of the proposed and actual structures. The instrument has already given useful assistance in a number of problems. Although it is introduced from the standpoint of optical transforms, the instrument could equally well be used with conventional computational methods. Also, since it is virtually a one-dimensional Fourier transformer, it may find applications in other fields. A.

548.735.7

3838. THE INTENSITY RATIO $K_{\bar{\alpha}} : K_{\beta}$ AS A SUGGESTION OF SELECTIVE VARIATION IN THE COMPOSITION OF AN ALLOY. F.Ebert.
Naturwissenschaften, Vol. 43, No. 12, 273-4 (1956). In German.

The intensity ratio $K_\alpha : K_\beta$ is about 4 : 1 if the radiation is reflected from a material of which the absorption edges are far removed from the wavelength of the radiation itself. Otherwise the ratio can be quite different. Use can be made of this in order to determine, for example, the form in which a particular element is present in an alloy. By using an X-ray tube with an anode containing two suitable elements the information can be obtained from observations of the reflections from a single plane. A.E.De Barr

548.735.7

3839. INTENSITY DISTRIBUTION OF X-RAY REFLECTIONS IN THE PRESENCE OF PRINCIPAL STRESSES OF THE FIRST AND SECOND KIND. G.K.Schmidt.
Naturwissenschaften, Vol. 43, No. 14, 321 (1956). In German.

A method of applying Warren and Averbach's analysis (Abstr. 6755/1950; 6187/1952). A.R.Stokes

548.736.1

3840. JOINT NOTE ON THE β-URANIUM STRUCTURE. C.W.Tucker,Jr, P.Senio, J.Thewlis and H.Steeple.
Acta cryst., Vol. 9, Pt 5, 472-4 (May, 1956).

Summarizes the points of view held by Tucker and Senio and by Thewlis and Steeple, respectively, as to the structure of β-uranium. The former, from the X-ray examination of single crystals of the β-retained phase in the 1.4% Cr alloy at room temperature, believe the structure to be centrosymmetrical at all temperatures; the latter, from X-ray powder photographs taken at 720° C and at room temperature, believe the structure to be non-centrosymmetrical in the β-stable range and centrosymmetrical at room temperature. Really decisive work with single crystals at high temperature is still lacking. J.Thewlis

548.736.3

3841. X-RAY ANALYSIS OF SHEARED-COMPRESSED KCl POWDER CRYSTALS. J.G.Kereiakes.
J. appl. Phys., Vol. 27, No. 12, 1557 (Dec., 1956).

See Abstr. 6631 (1955). Compression and shearing produces completely transparent disks at 40 000 lb/in^2, as compared with 125 000 lb/in^2 required with no shearing stress. X-ray diffraction photographs indicate strong preferred orientation in sheared specimens. A.R.Stokes

548.736.4

3842. SYMMETRY OF THE LOW-TEMPERATURE PHASE OF $BaTiO_3$. F.Jona and R.Pepinsky.
Phys. Rev., Vol. 105, No. 3, 861–4 (Feb. 1, 1957).

X-ray Weissenberg patterns of a barium titanate crystal in the low-temperature phase (below –90° C) show that the spacings along the perovskite cubic axes are equal and that thec ube faces are sheared through a small angle, i.e., the unit cell has rhombohedral character. Optical examination of these crystals in electric fields, together with dielectric constant measurements, suggest that the cell is only pseudorhombohedral. The true symmetry appears to be lower and may possibly be monoclinic (point group 2 or m). The contradictions in the early dielectric measurements are explained by this assumption. A.

548.74

3843. X-RAY AND NEUTRON DIFFRACTION STUDY OF ANTIFERROELECTRIC LEAD ZIRCONATE, $PbZrO_3$. F.Jona, G.Shirane, F.Mazzi and R.Pepinsky.
Phys. Rev., Vol. 105, No. 3, 849-56 (Feb. 1, 1957).

The room-temperature structure has been studied. The symmetry is orthorhombic (pseudotetragonal) with lattice parameters a = 5.88 A, b = 11.77 A, c = 8.22 A. The space group is Pba2 and there are 8 formula units in the unit cell. The structure results from slight distortions of the cubic perovskite lattice, which the crystal assumes above 230° C. With respect to the ideal perovskite structure, Pb atoms suffer antiparallel shifts along the former cubic [110] direction; oxygen atoms also suffer antiparallel shifts within the (001) plane and, in addition, unbalanced antiparallel shifts along the c direction. The noncentric symmetry is in accord with the presence of a small piezoelectric effect as reported by Roberts. The oxygen octahedra surrounding the Zr atoms appear to be distorted, and it is possible to explain the strong optical anisotropy within the (001) plane as well as the pseudotetragonality (b = 2a). A.

548.74

3844. NEUTRON DIFFRACTION STUDY OF ORTHORHOMBIC $BaTiO_3$. G.Shirane, H.Danner and R.Pepinsky.
Phys. Rev., Vol. 105, No. 3, 856-60 (Feb. 1, 1957).

The atomic positions of ferroelectric $BaTiO_3$ in its orthorhombic phase have been determined by a single-crystal neutron diffraction analysis. Piller-shaped crystals with their major axes along the cubic [110] direction were maintained as single domains by the application of an electric field. The structure deduced can be viewed as a framework of slightly distorted oxygen octahedra, in which the central Ti ions are displaced towards one of the octahedron edges (polar axis) by 0.13 A. The Ba ions are also shifted in the same direction but by the smaller amount of 0.07 A. A comparison of this structure with that of the tetragonal phase suggests the essential role of Ti in the ferroelectricity of this crystal as treated by Slater. A.

548.74

3845. STACKING FAULTS IN VACUUM EVAPORATED CRYSTALS OF COPPER AND SILVER. T.B.Rymer, F.J.Fayers and S.J.Hewitt.
Proc. Phys. Soc. B, Vol. 69, Pt 10, 1059-61 (Oct., 1956).

A new investigation of the line-profile of electron diffraction rings from evaporated copper films has been carried out. This shows that the line-width is due to a random distribution of strains and not to crystallite size or to stacking faults. The latter, as suggested by Garrod (Abstr. 4040/1956) may well contribute to the displacement of the diffraction rings from copper films but do not cause the major part of it. Garrod's theory, however, was found to apply to evaporated silver films. K.W.Plessner

548.74 : 538.245

NEUTRON DIFFRACTION STUDY OF THE MAGNETIC STRUCTURES IN Cu—Mn ALLOYS. See Abstr. 3457

GEOPHYSICS 55

550.38.08 : 539.152.2

EARTH'S MAGNETIC FIELD MEASUREMENT BY NUCLEAR MAGNETIC RESONANCE. See Abstr. 3548

550.8

3846. POST-WAR DEVELOPMENTS IN GEOPHYSICAL INSTRUMENTATION FOR OIL PROSPECTING. D.T.Germain-Jones.
J. sci. Instrum., Vol. 34, No. 1, 1-8 (Jan., 1957).

Noteworthy advances have been made in geophysical apparatus for oil prospecting purposes over the past twelve years. Highly sensitive apparatus for accurate registration in an aeroplane of anomalies in the earth's magnetic field is being employed with considerable success. Gravimeters weighing only 5 lb and measuring changes in the earth's gravitational field with an accuracy of the order of 1×10^{-8} g are in widespread use. Highly portable low frequency seismic apparatus will register with ease refracted waves up to distances of twenty miles, and seismic reflection equipment of complex design, but rugged and portable, will record reflections of various frequencies from depths of many thousands of feet. Routine seismic surveys are conducted from ships over water-covered areas, and for accurate location purposes on surveys over pospects under the sea it is customary to employ radio surveying aids. The recent introduction of magnetic recording for seismic surveys offers wide scope for improvements in the seismic technique; and new methods of displaying the recorded information are likely to help greatly the process of interpretation. Remarkable ingenuity has been shown in the development of radioactive and other forms of well-logging devices. A.

ATMOSPHERE. METEOROLOGY 551.5

551.508.8 : 551.55

3847. RADAR IN METEOROLOGY. M.Hinzpeter.
Elektron. Rdsch., Vol. 10, No. 8, 223-4 (Aug., 1956). In German.

Brief description of radar as a meteorological aid. Balloons

carrying corner reflectors can be used for wind speed measurements and radar sondes may be used for more elaborate investigations. The sources of error are discussed and the Mullard radar sonde is described in some detail. C.A.Hogarth

551.508.8

3848. THE MEASURE OF THE CONDUCTIVITY BY RADIOSONDE. L.Koenigsfeld.
Publ. Inst. Roy. Météorol. Belgique, No. B18, 8 pp. (1955). In French.

Describes a modification of the method of Gerdien using a cylindrical condenser to measure the conductivity of the atmosphere. The apparatus has been fitted to a standard Kew pattern radiosonde and one example of the results obtained is given. J.M.Hough

551.508.8

3849. FACTORS INFLUENCING RADAR-ECHO INTENSITIES IN THE MELTING LAYER. R.Wexler, D.Atlas and B.J.Mason.
Quart. J. Roy. Meteorol. Soc., Vol. 82, 349-51 (July, 1956).

Mason's conclusions regarding the aggregation and orientation of melting snowflakes and measurements of radar-echo intensities in the melting layer are criticized. It is shown that growth of particles in the melting layer may be quite appreciable even without an updraught due to growth in the saturated air caused by cooling of the air by melting snow. Recent radar measurements are quoted which conflict with the view that the melting particles scatter the radiation as horizontally-orientated oblate spheroids of diameter/axis ratio equal to 4. Revised equations are also given for the interpretation of the melting layer. In reply Mason considers the correction due to the growth of the snowflakes in the melting layer is rather small and it is reasonable to neglect it. He agrees there is only a rather small preference for the melting snowflakes to be horizontally orientated but doubts whether the radar evidence at this stage is conclusive. R.S.Read

551.508.96 : 621.396.91

3850. DESIGN AND DEVELOPMENT OF A SIMPLE IONOSPHERIC EQUIPMENT. T.V.S.Murty.
J. sci. industr. Res., Vol. 15A, No. 2, 70-4 (Feb., 1956).

Description of a simple ionospheric sounding equipment of conventional design, giving a peak power output of 10-25 kW. The transmitter unit consists of a c.w. oscillator switched electronically by a d.c. pulse generator. The receiver is a superhet with no a.v.c. system and no RC coupling in all predetector stages. Sensitivity and selectivity curves are given. G.M.Brown

551.510.535

3851. ELECTRON DENSITY IN A NON-ISOTHERMAL ATMOSPHERE. F.Mariani.
Ann. Geophis., Vol. 9, No. 1, 43-62 (Jan.. 1956). In Italian.

General relations are given, and the distributions of ionization intensity and electron density are determined for atmospheric models assuming (i) a constant temperature gradient at all heights, and (ii) a constant gradient up to a certain height c, and zero temperature gradient above this height. Marked effects of earth curvature are found near sunrise and sunset, and it is proposed that the height c may correspond to that of the separation of the F1 and F2 layers. It is shown that the "parabolic layer" assumption is not valid for frequencies $> (0.7\text{-}0.8)\, fc$. G.M.Brown

551.510.535

3852. TEMPERATURE AND ELECTRON DENSITY OF THE F-REGION OF THE IONOSPHERE. F.Mariani.
Ann. Geofis., Vol. 9, No. 2, 245-71 (April, 1956). In Italian.

It is concluded that the anomalies of the F2 layer cannot be satisfactorily explained on the basis of diurnal and seasonal variations in temperature, since the variations postulated are too large. Assuming that the F1 and F2 layers are produced by the same ionization process, and that bifurcation takes place at a discontinuity of temperature gradient as proposed in the preceding abstract, theoretical ionization curves are calculated for latitude 45^0, and it is shown that several F-layer anomalies may be accounted for. G.M.Brown

551.510.535

3853. ON THE DIFFUSION OF ELECTRONS IN THE IONOSPHERE. F.Mariani.
Ann. Geofis., Vol. 9, No. 2, 219-31 (April, 1956). In Italian.

Considering the atmosphere as a binary mixture of an ion-electron and a molecular gas having a constant temperature gradient the effect of diffusion on the electron density is calculated for an equinox day at the equator. It is concluded that the effects are always negligible in the E and F1 layers, and are only in the nature of perturbing effects in the F2 layer. G.M.Brown

551.510.535 : 523.78

3854. BEHAVIOUR OF THE IONOSPHERE AT ROME DURING THE PARTIAL SOLAR ECLIPSE OF 30 JUNE 1954. P.Dominici.
Ann. Geofis., Vol. 9, No. 1, 107-32 (Jan., 1956). In Italian.

A more detailed treatment of a previous paper. For summary of results, see Abstr. 7045 (1956). G.M.Brown

551.510.535

3855. IONOSPHERIC OBSERVATIONS AT BANARAS DURING THE TOTAL SOLAR ECLIPSE ON 20 JUNE 1955. D.K.Banerjee, P.G.Surange and S.K.Sharma.
J. sci. industr. Res., Vol. 14A, No. 11, 517-21 (Nov., 1955).

The signal strengths of short wave-transmissions received by 1-hop and 4-hop propagation from different senders show different variations over the eclipse period. These are explained in terms of the relative roles played by decreased reflection coefficient and decreased absorption during eclipse. Vertical incidence measurements for the F2-layer (critical frequency, semithickness and height of lower boundary) can be explained consistently in terms of thermal contraction and expansion. G.M.Brown

551.510.535

3856. INVESTIGATION OF WINDS IN THE IONOSPHERE BY SPACED RECEIVER METHOD. B.Ramachandra Rao, M.Srirama Rao and D.Satyanarayana Murthy.
J. sci. industr. Res., Vol. 15A, No. 2, 75-81 (Feb., 1956).

The conventional spaced-receiver fading method of observing ionospheric movements has been employed in India using spacings of the order of 100 m and recording the three traces simultaneously on a triple-beam c.r.o. Results for 1954 for the E- and F-regions using frequencies of 2.4 and 5.9 Mc/s respectively are displayed on harmonic dials and compared with those obtained by other workers. G.M.Brown

551.510.535 : 523.75

3857. IONOSPHERIC CHANGES ASSOCIATED WITH THE SOLAR EVENT OF 23 FEBRUARY 1956. C.M.Minnis, G.H.Bazzard and H.C.Bevan.
J. atmos. terrest. Phys., Vol. 9, No. 4, 233-4 (Oct., 1956).

Preliminary account of observed changes in the horizontal component of the geomagnetic field and in ionospheric absorption at the stations Singapore, Inverness and Slough. Tentative conclusions are given. G.M.Brown

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.510.536 : 621.396.821

3858. A METHOD TO DETECT THE PRESENCE OF IONIZED HYDROGEN IN THE OUTER ATMOSPHERE. L.R.O.Storey.
Canad. J. Phys., Vol. 34, No. 11, 1153-63 (Nov., 1956).

The method proposed relies on the influence of the positive ions on the propagation of whistlers. If ionized hydrogen is the chief constituent of the atmosphere at great heights above the earth, then the relation between frequency and time in a whistler should depart at low audio frequencies from the form observed at higher frequencies. The departure is likely to be most marked in whistlers occurring at low magnetic latitudes. At magnetic latitude 45^0 the effect of the hydrogen ions should be detectable at frequencies below about 2 kc/s. A.

551.521.1

3859. THE USE OF SOLAR ENERGY. V.A.Baum.
J. sci. industr. Res., Vol. 14A, No. 8, 365-73 (Aug., 1956).

Methods of collecting solar energy and harnessing it to various types of installation are reviewed. Requirements concerning location, predominant weather conditions and local fuel needs are considered. E.H.Dock

551.555.4

3860. THE THEORY OF STRONG KATABATIC WINDS. F.K.Ball.
Austral. J. Phys., Vol. 9, No. 3, 373-86 (Sept., 1956).

In regions where strong katabatic (blowing down slopes that are cooled by radiation) winds occur, notably Commonwealth Bay,

Antarctica, there is often a sharp boundary between the strong winds and the comparatively calm conditions at sea. The seaward movement of this boundary across a coastal station is accompanied by a sudden onset of strong winds and the landward movement by their sudden cessation. The boundary has all the characteristics of a pressure jump line accompanying a sudden change in depth of the cold air. Furthermore, it is to be expected from theoretical considerations that a pressure jump will occur near the coast. A simple theory is developed from which various characteristics of the flow can be predicted, including the intensity of the jump and the deviation of the wind from the lines of greatest slope caused by the earth's rotation. These predictions agree moderately well with observations. A.

551.576.1 : 551.578.11

3861. DIMENSION DISTRIBUTION FUNCTION OF CLOUD AND RAIN DROPS. L.M.Levin.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1045-8 (1954). In Russian.

A logarithmically normal distribution function is proposed. This distribution law is verified by data collected for the rain and cloud drops. Some of the other known distribution functions are shown to be approximations of the logarithmically normal function. Z.Krasucki

551.594.14

3862. NATURAL AND ARTIFICIAL RADIOACTIVITY OF THE ATMOSPHERE. O.Tanaevsky and E.Vassy.
Ann. Géophys., Vol. 11, No. 4, 486-90 (1955). In French.

Describes measurements at Val-Joyeux (48° 49' N, 2°1' E) of the radioactivity of the air during the period Dec. 1953 to July 1955, and of the atmospheric precipitations during Jan. to July 1955. The radioactivity of the air was due to radon and showed no annual variation but did show a tendency to increase in calm weather. The rain and snow contained artificial radioactive particles and these were related to atomic explosions. J.M.Hough

BIOLOGY 57/59

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

61

612.843

3863. THE INFLUENCE OF RECOGNITION OF THE TEST OBJECT IN OBSERVATIONS WITH A TELESCOPE. L.Ronchi and M.T.Zoli.
Atti Fond. Ronchi, Vol. 11, No. 1, 72-84 (Jan.-Feb., 1956). In Italian.

An experiment is described in which the observer is asked to judge the size of a test object at varying distances. The results indicate that with an unknown test object, the unaided eye judges by apparent size, and with a telescope by the visual angle. When known objects are viewed, the judgement is intermediate between these two. R.W.Fish

612.843

3864. AN INVESTIGATION OF THE FACTORS WHICH INFLUENCE THE LOCATION OF AN IMAGE SEEN THROUGH A TELESCOPE. L.Ronchi and M.T.Zoli.
Atti Fond. Ronchi, Vol. 11, No. 3, 270-83 (May-June, 1956). In Italian.

An experiment is described in which the observer compares the position of a test object seen with the naked eye, with the position of another test object seen through a telescope. The results indicate that the location of the image depends upon a number of psychological as well as physical factors. R.W.Fish

612.843.2

3865. LIGHT ENERGY AND BRIGHTNESS SENSATION. R.G.Hopkinson.
Nature (London), Vol. 178, 1065–6 (Nov. 10, 1956).

The relation between brightness sensation M and the luminance L is found to be $M = kL^{0.3}$ for a dark surround and $M = kL$ when the adapting luminance is 450 ft L. R.A.Weale

612.843.31

3866. COLOR DISCRIMINATION OF TWELVE OBSERVERS. W.R.J.Brown.
J. Opt. Soc. Amer., Vol. 47, No. 2, 137-43 (Feb., 1957).

The sensitivities of twelve normal observers to small colour differences were determined by studying the distribution of colour-matching errors about a colour centre. Twenty-two colour centres were used. These were distributed throughout the chromacity diagram. The average luminance of the colours was 4.9 ft-L. The matching field size subtended 10° at the observer's position. The remainder of the visual field was filled with a white surround. The data for the twelve observers are found to be in general agreement with previous experiments although some differences appear significant. A.

612.843.31

3867. THE THEORIES OF COLOUR VISION. H.W.Müller-Limmroth.
Naturwissenschaften, Vol. 43, No. 15, 337-46 (1956). In German.

A review of the anatomical basis underlying formal theories of colour vision. R.A.Weale

612.843.613

3868. FURTHER MEASUREMENTS OF THE DIFFERENTIAL THRESHOLD IN THE PRESENCE OF A SPATIAL ILLUMINATION GRADIENT. A.Fiorentini.
Atti. Fond. Ronchi, Vol. 11, No. 1, 67-71 (Jan.-Feb., 1956).

Previous measurements (Abstr. 4128/1955) on the differential threshold were extended by making the 5-star test field alternately brighter and darker than the surround. The mean threshold, obtained in this manner, agrees well with the measurements derived from experiments in which the differential stimulus was only positive. R.A.Weale

612.843.63

3869. ON THE VARIATION OF THE SHAPE OF THE ISOPTER LINES DUE TO EXTRA-FOVEAL VISUAL ACUITY. L.Mosci.
Atti Fond. Ronchi, Vol. 11, No. 1, 61-6 (Jan.-Feb., 1956). In Italian.

Peripheral visual acuity (measured with a white line on a black background) is improved in emmetropic subjects approximately by 40%, when they wear a −2.5 cyl, perpendicular to the meridian examined. The improvement is not uniform in all meridians, a finding which supports the view that residual optical defects affected the work. R.A.Weale

612.85

3870. THE SIGNIFICANCE OF TIME FACTORS FOR THE PERCEPTION OF COMPLEX SOUNDS. L.A.Chistovich.
Akust. Zh., Vol. 2, No. 3, 310-16 (1956). In Russian.

The experiments were devised to study the differentiation by humans of a complex sound signal against a complex interference background. The spectra of signal and noise are given and curves showing (a) the relationship of the levels of the signal and the interference necessary for the recognition of both, (b) dependence of the threshold of recognition of the signal upon the intensity level of the interference, (c) dependence of the response to a signal upon the relative levels of the components. The differing effects obtained when the signal and the interference are switched on one after the other and when both are heard simultaneously are also studied. It is concluded that the experiments prove the high importance of the time factor in differentiating the useful signal from the interference. C.R.S.Manders

612.85

3871. DETERMINATION OF THE NORMAL HEARING REFERENCE ZERO. A.Glorig, R.Quiggle, D.E.Wheeler and W.Grings.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1110-13 (Nov., 1956).

The present American normal hearing reference zero is considered by many investigators to be too high. The data from two recent studies on normal hearing provide a possible explanation. One of these studies, which was a survey type study, confirmed the present reference zero. The second study, a laboratory type study, confirmed the results of other laboratory studies that had led to the opinion that the present zero is too high. In the authors' opinion, the difference between the results of these two studies and various other studies of the auditory threshold are due to the inherent difference in experimental technique in laboratory and survey type studies. In establishing a normal hearing reference zero, it is no longer a question of resolving differences in various studies but a question of whether survey or laboratory data will be used. A.

612.85

3872. SOURCE AND RECEIVER BEHAVIOR IN THE USE OF A CRITERION. J.P.Egan and F.R.Clarke.
J. Acoust. Soc. Amer., Vol. 28, No. 6, 1267-9 (Nov., 1956).

A listener in an articulation test is confident of some of his responses and dubious about others. On the basis of this fact, it is reasonable to require that a receiver decide whether or not his response is correct. If he adopts various criteria from test to test, a receiver operating characteristic may be obtained which will be one way of describing quantitatively this type of behaviour. The curve showing the confirming and rejecting behaviour of the receiver is compared to that of the source using the same test materials and the same speech-to-noise ratio. A.

TECHNIQUE. MATERIALS 62/69

621.941

3873. THE GENERATION OF ACCURATE CYLINDERS. D.A.Davies.
J. sci. Instrum., Vol. 33, No. 12, 501-2 (Dec., 1956).

A method of diamond-turning accurate cylinders for the production of helical rulings is described. Details are given of the special tool holder, and performance figures quoted show that, for a typical cylinder, the central half may be held constant in diameter to ± 10μ in. A.

66.041

3874. A SMALL VACUUM INDUCTION FURNACE. J.C.Matthews.
J. sci. Instrum., Vol. 34, No. 2, 62-3 (Feb., 1957).

Melts on a laboratory scale, up to 300 g, may be made under high vacuum. Material may be added to the crucible from a hopper and the melt cast into a split copper mould while under high vacuum. The furnace is used in conjunction with a high-voltage, high-frequency generator, and although intense ionization occurs this does not affect the functioning of the furnace. A.

PHOTOGRAPHY 77

77.023.41

3875. CONTROLLED DEVELOPMENT FOR NUCLEAR EMULSIONS. J.M.Blum.
Rev. sci. Instrum., Vol. 27, No. 11, 938-9 (Nov., 1956).

A method consisting of separating the active phase of the development of nuclear emulsions into two or more stages is presented. The purpose of this procedure is to obtain a reproducible degree of development of these emulsions at some prefixed level of sensitivity. Preliminary results are reported. A.

771.53

3876. RELATION BETWEEN GRANULARITY AND AUTOCORRELATION. A.Marriage and E.Pitts.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1019-27 (Dec., 1956).

The transmission fluctuations of a grainy film can be measured in several ways, for instance: (a) the standard deviation of the transmission of a single aperture as a function of its size, (b) the standard deviation of the difference in transmission between two adjacent apertures as a function of their size, (c) the correlation curve: the variation of the mean of the product of the transmissions of two apertures as a function of their separation. When the apertures are slits, it is shown that if any one of these is known, the others can be calculated from it. These conclusions are valid also if a reasonable approximation is made to the effect of finite resolving power on the edge of the slits. For circular apertures, (a) can be calculated from (c) and vice versa. It is suggested that the correlation curve can always in principle be found from (a), when the aperture edge is sharp. An analogous result may also be possible for the case of unsharp edges. The analogous density measurements can be similarly interrelated if the form of the frequency distribution of individual readings is known. It is concluded that the various methods of computing granularity as a function of the linear dimensions of the optical system all give the same information in different forms. A.

771.53

3877. CONTRIBUTIONS ON THE MECHANISM OF STABILIZATION OF PHOTOGRAPHIC EMULSIONS. V. PHYSICO-CHEMICAL AND PHOTOGRAPHIC INVESTIGATION OF THE HOMOLOGUES OF AN AZA-INDOLIZINE SERIES. E.J.Birr.
Z. wiss. Photogr., Vol. 50(I), No. 1-12, 107-24 (1955). In German.

Data are given for the solubility of silver salts of a series of 5-alkyl (R) derivatives of 7-oxy 2.3.4-triazaindolizine, and for the adsorption of the homologues on AgBr suspension under controlled conditions. If the adsorbed concentration at equilibrium is x, starting from an initial concentration c, the results are expressed by activity coefficients in the form $f_x = a.f_{c-x} + b$ for each of the compounds used (R varying from H to $C_{11}H_{23}$). Hence a general increase of adsorption is demonstrated to accompany decreasing solubility of the silver salt or increasing size of R, though with a minimum in adsorption at R = C_3H_7. Equivalent amounts of the homologues added to an emulsion decrease the sensitivity more as R increases, but when the additions are arranged to produce equal adsorbed amounts, the results are more complicated. The variation of sensitivity and clarity after storage of the emulsion, with respect to the size of R, both correlate well with the proportion of non-adsorbed additive up to R = C_4H_9, and also for higher members if allowance is made for the loss of sensitivity due to additives of higher molecular weight. Stabilization is considered mainly due to that part of the additive left in the gelatine phase. S.T.Henderson

771.53

3878. CONTRIBUTIONS ON THE MECHANISM OF STABILIZATION OF PHOTOGRAPHIC EMULSIONS. VI. FURTHER INVESTIGATIONS OF THE ADSORPTION OF THE AZA-INDOLIZINES ON THE SILVER HALIDE GRAINS OF PHOTOGRAPHIC EMULSIONS. E.J.Birr.
Z. wiss. Photogr., Vol. 50(I), No. 1-12, 124-38 (1955). In German.

In the presence of sensitizing dyes, 5-methyl 7-oxy 2.3.4-triazaindolizine (I) is scarcely adsorbed on AgBr, while the normal dye adsorption is not much affected. As expected (see preceding abstract) emulsions suffer no loss in keeping properties under these conditions, since the unadsorbed additive is largely responsible, nor is there any loss in sensitivity due to the dye. The effect of indolizine homologues on keeping the developer clear during use varies with the compound. Compared with other known preservatives, the compound I (R = CH_3)

is ineffective, but higher members up to R = C_9H_{19} show increasing action correlated with their increasing adsorption on AgBr. The blue-toning effect on developed Ag reaches a maximum at R = C_6H_{13}.
S.T.Henderson

771.53

3879. THE NATURE OF PHOTOGRAPHIC SENSITIVITY. J.W.Mitchell.
Z. Elektrochem., Vol. 60, No. 6, 557-62 (1956). In German.

A review (no refs.) of the methods and theories of the Bristol school, based on the main ideas that sensitivity centres are crystal defects, and that the latent image consists of groups of silver atoms stabilized by adsorption on Ag_2S molecules. The subjects discussed include the preparation of silver halides in large single crystal and microcrystal forms, and the properties of these both unsensitized and chemically sensitized; the nature of sensitivity centres and chemical sensitization; and the formation of the latent image and solarization.
S.T.Henderson

771.53

3880. SOME CONSIDERATIONS ON THE THEORY OF THE PHOTOGRAPHIC LATENT IMAGE. H.Staude.
Z. Elektrochem., Vol. 60, No. 6, 563-5 (1956). In German.

Mitchell's theory (see preceding abstract) is not in accord with some experimental facts, for example the adsorption of quinone on the latent image. It is suggested that the latent image consists, not of silver aggregates, but of F-centres on the AgBr crystal surfaces. This accounts for a number of phenomena, including solarization by the transition from F-centres to silver aggregates.
S.T.Henderson

771.534

3881. CONTACT POTENTIAL DIFFERENCE BETWEEN SENSITIZING DYE AND SUBSTRATE. R.C.Nelson.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1016-19 (Dec., 1956).

The contact potential difference between cadmium sulphide and the sensitizing dyes pinacyanole, kryptocyanine, and neocyanine has been measured by the electron beam retardation method and found to be of the order of 0.3 V in each case. That between silver bromide and pinacyanole has also been measured to be 0.38 V, the dye in all cases having the smaller electron affinity. These results confirm the tenability of the Gurney—Mott electron transfer mechanism of dye sensitization in photography. Using the same method the electron affinity of pinacyanole has been found to be about 3.1 eV; that of silver bromide is thus approximately 3.5 eV, in agreement with previous estimates.
A.

771.534.531

3882. MICRODENSITOMETER FOR PHOTOGRAPHIC RESEARCH. J.H.Altman and K.F.Stultz.
Rev. sci. Instrum., Vol. 27, No. 12, 1033-6 (Dec., 1956).

A recording microdensitometer is described that has a resolving power of 800 lines/mm when the scanning aperture is 1μ wide and 200μ long. The response is linear in density to 3.0 for the same aperture. By narrowing the aperture to 0.1μ, the resolving power can be increased to 1800 lines/mm. The record is made either on chart paper with rectangular coordinates, on punched cards, or on both.
A.

771.534.57 : 535.412

SOLARIZATION TECHNIQUE FOR INTERFEROGRAMS. See Abstr. 3169

771.535

3883. INVESTIGATIONS ON THE FADING MECHANISM IN NUCLEAR PLATES (AGFA K-PLATES). W.Lohmann.
Z. Naturforsch., Vol. 11a, No. 7, 592-8 (July, 1956). In German.

The essential reaction in the fading of the latent image before development is the ionization of silver atoms, for which the energy is presumably derived from lattice vibrational energy. The free electrons may then be removed by water, forming H + OH^-, with subsequent reactions to HO_2 and H_2O_2 and back to H_2O and O_2. The mechanism of these changes is discussed. Experiments on the acceleration of fading by heat, humidity and oxidizing agents are described in support.
S.T.Henderson

771.535

3884. CONSIDERATIONS OF EXPERIMENTAL METHODS IN THE STUDY OF THE LATENT IMAGE. A.Hautot.
Z. wiss. Photogr., Vol. 50(I), No. 1-12, 243-52 (1955). In German.

A discussion of the present unsatisfactory and speculative nature of theories concerning the nature of sensitivity centres and of the latent image. Experimental methods in use are classified, and the difficulties of interpretation dealt with in detail. These difficulties are: (1) the wide spread in particle size in emulsions; (2) the multilayer nature of most emulsions; and (3) the impossibility of direct observation of the latent image. Concerning (3), the number of affected molecules must be increased by 10^8 to 10^9 times by development, when further uncertainty results from the difference between physical and chemical development; or the photolytic silver may be made visible to direct or microscopic observation by excessive exposures, a process which may be different from normal latent image formation; or comparison may be made with macroscopic crystals of silver halides which, however, will have different lattice defects from micro-crystals in emulsions, and will show volume rather than surface effects. Only phenomena dependent on spatial distribution of centres are well understood, for example the Herschel and Sabattier effects.
S.T.Henderson

772.1 : 778.34

3885. STUDY OF THE DISSOLUTION OF SILVER GRAINS FROM THICK NUCLEAR PLATES IN THE FIXER. G.Thuro and M.Paić.
Nuovo Cimento (Ser. 10), Vol. 4, No. 4, 887-97 (Oct., 1956). In French.

Experiments are reported showing that dissolution of silver may be inhibited by eliminating (as far as possible) oxygen from the fixing bath, and adding either sodium bisulphite or sodium sulphite plus acetic acid. Details of composition and preparation of a recommended fixing bath are given.
J.J.Wilkins

778.3 : 620.193

3886. THE COMPOSITION OF THE PHOTOGRAPHICALLY ACTIVE PARTICLES PRODUCED BY METALS UNDER ATMOSPHERIC CORROSION. I.L.Roĭkh.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1117-20 (1954). In Russian.

The spectral sensitivity of photographic plates was determined three times as follows: first for exposure to light alone, secondly, for exposure to light followed by exposure at about 2 mm distance to a solution of H_2O_2; thirdly, for exposure to the solution followed by exposure to light. The third case produced lower densities than the other two. Similar results were obtained when a fresh Zn surface was placed 0.2 mm from the plate but when Na_3AsO_3 solution and $HgCl_2$ solution were used the sensitivity was depressed in all cases. From the identity of the results it is concluded that H_2O_2 is the active agent responsible for the photographic action of corroding metals.
A.L.Mackay

778.34

3887. ON A METHOD FOR DISCRIMINATING BETWEEN CHARGED PARTICLES IN NUCLEAR EMULSIONS BY PHYSICAL DEVELOPMENT. P.Cüer, C.Gégauff and J.P.Lonchamp.
C.R. Acad. Sci. (Paris), Vol. 243, No. 8, 709-12 (Aug. 20, 1956). In French.

Various methods have been tried in an attempt to increase the discrimination between the tracks of charged particles in Ilford C2 emulsion. It has been found that a short chemical development in a normal solution followed by a physical development in a developer of the Rzymkowski type gives very good (60%) discrimination between the tritons and α-particles from the $Li^6(n,\alpha)t$ reaction. The visibility of tracks against a heavy background due to γ-radiation has also been examined as a function of development.
D.J.A.Prowse

778.34

3888. AN ELECTRONIC SCANNER FOR NUCLEAR EMULSIONS. E.Amaldi, C.Castagnoli and C.Franzinetti.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1165-73 (Nov., 1956).

This instrument makes it possible to count and record tracks produced by almost parallel particles such as those obtainable from an accelerator. The general principles of electronic scanners are discussed. A description of the main features of the apparatus, is given and some preliminary results are reported.
A.

778.34

3889. PHOTOMETRIC ANALYSIS OF THE TRACKS IN NUCLEAR EMULSIONS. I. EXPERIMENTAL ARRANGEMENT. M.Della Corte.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1565-9 (Dec., 1956). In Italian.

A simple apparatus for the photometric analysis of the tracks in nuclear emulsions is described. The optically magnified image of a portion of a track is formed on the plane of a slit and parallel to it, after having been reflected by a movable mirror. This mirror is fastened to the moving coil of a d.c. instrument, suitably modified to respond to 50-100 c/s a.c. When a.c. is supplied to the coil the image is accordingly displaced sinusoidally in the direction normal to the slit. The variable luminous flux through the slit modulates the output current of a photomultiplier. This current is amplified and displayed on the y-axis of a cathode-ray oscillograph, whose x-axis is swept by an a.c. of the same frequency and suitable phase. The photometric profile thus appears on the screen without appreciable deformation. The total magnification is about 20 to 30 thousand times. The working speed is 500 μ of track every hour; the precision of the width measurements is about 2-3%. A.

778.37

3890. HIGH-SPEED PHOTOGRAPHY. J.S.Courtney-Pratt.
Nature (London), Vol. 178, 1440-2 (Dec. 29, 1956).

Report of the Third International Congress on High-Speed Photography held in September 1956 in London. A.

LIST OF JOURNALS

The following list supplements the Lists of Journals published with the January number of Volume 56 (1953) and the Supplements published with the Indexes to Volumes 56 (1953), 57 (1954), 58 (1955) and 59 (1956). Copies of the numbers containing these lists can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Amer. Soc. Test. Mater. Bull.	American Society for Testing Materials. Bulletin. [Abstracted by the Electrical Research Association.]
Ber. Dtsch. Keram. Gesell.	Berichte der Deutschen Keramischen Gesellschaft. [Article reprinted in Entwicklungsber. Siemens & Halske.]
Chem. and Industr.	Chemistry and Industry. [Abstracted by the Central Electricity Authority Digest.]
Elect. Manufng	Electrical Manufacturing. [Abstracted by the Central Electricity Authority Digest, and the Electrical Research Association.]
J. Text. Inst.	Journal of the Textile Institute. [Abstracted by the Electrical Research Association.]
Rozprawy Elektrotech.	Rozprawy Elektrotechniczne. Panstwowe Wydnawnictwo Naukowe, Krakowskie Przedmiescie 79, Warsaw.

NEW JOURNALS

I.B.M. J. Res. Developm.	IBM Journal of Research and Development. International Business Machines Corporation, 590 Madison Avenue, New York 22, N.Y. Quarterly. Vol. 1, No. 1 dated Jan., 1957.
Kristallografiya	Kristallografiya. Akademiya Nauk SSSR, Cherkasskiĭ per., 2, Moscow. Vol. 1, No. 1 dated 1956.

NOTE.

Radio and Televis. News	Radio and Television News. Title changed to Radio and TV News with issue dated April, 1957.

ERRATA

Author Index (1955)	p. 1408, column 2 : Matthews,P.T.; transfer entry "Propagators of quantized field, 7682" to be under "Matthews,P.T. and Salam,A."
	p. 1439, column 2 : Salam,A.; insert "7682" after "Matthews,P.T., 716, 3140".
Author Index (1956)	p. 1048, column 1 : Fan,H.Y.; add entry "Valence semi-conductors, germanium and silicon, 6038".
	p. 1060, column 1 : insert "Ham,F.S. The quantum defect method, 6038".
	p. 1066, column 1 : Hornig,D.F.; for "See also Anderson,W.H." read "See also Andersen,W.H."
	p. 1096, column 2 : insert "Muto,T. and Takagi,Y. The theory of order-disorder transitions in metals, 6038".
	p. 1105, column 2 : insert "Pines,D. Electron interaction in metals, 6038".
	p. 1109, column 2 : insert "Reitz,J.R. Methods of one-electron theory of solids, 6038".
	p. 1117, column 2 : insert "Seitz,F. See Wigner,E.P., 6038".
	p. 1126, column 2 : Takagi,Y.; add "Muto,T., 6038".
	p. 1138, column 1 : insert "Wigner,E.P. and Seitz,F. Qualitative analysis of the cohesion in metals, 6038".
Abstr. 770 (1957)	line 23 : for "M.A.Guinier" read "A.Guinier".
Abstr. 2066 (1957)	line 4 : for "R.E.Schrader" read "R.E.Shrader".
Abstr. 2079 (1957)	line 8 : for "plane" read "plate".
Abstr. 2290 (1957)	: insert journal reference: "Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 439-48 (1956). In Russian."
Abstr. 2354 (1957)	lines 5 and 9 : for "cloud length" read "chord length".

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